Issued July 1968

SOIL SURVEY

Thayer County, Nebraska

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF NEBRASKA
Conservation and Survey Division

Major fieldwork for this soil survey was done in the period 1958–63. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1964. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska Conservation and Survey Division as a part of the technical assistance furnished to the Thayer County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All of the soils of Thayer County are shown on the detailed map at the back of this survey. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with numbers on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by a symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability units, range site, and windbreak group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the sections "Management by Capability Units" and "Woodland and Windbreaks."

Game managers, sportsmen, and others concerned with wildlife can find information about soils and wildlife in the section "Management of the Soils for Wildlife Habitats and as Recreation Areas."

Ranchers and others interested in range can find, under "Range Management," groupings of the soils according to their suitability for range, and also the names of plants that grow on each range site.

Engineers and builders can find under "Engineering Properties of the Soils" tables that give estimated engineering properties of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Genesis and Classification of the Soils."

Newcomers in Thayer County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover: Terraces, waterways, and contour farming on soils of the Geary-Hastings association. Photo courtesy of Richard Hufnagle.

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REPORT BY ROBERT S. POLLOCK, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY ROBERT S. POLLOCK, LYLE L. DAVIS, AND VERNON SEEVERS, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

THAYER COUNTY is in the southeastern part of Nebraska (fig. 1). It has a total area of 577 square miles, or 369,280 acres. Hebron, the county seat and largest town, is at about the center of the county. Agriculture in the county is based on general livestock farming and cash-grain farming. About three-fourths of the acreage is cultivated, a little less than one-fourth is in grass, and a small part is in woodland. Deep-well irrigation is important in agriculture.

The principal dryland crops are sorghum, wheat, corn, and alfalfa. Corn and grain sorghum are the principal irrigated crops. The livestock in the county are mainly beef cattle and swine.

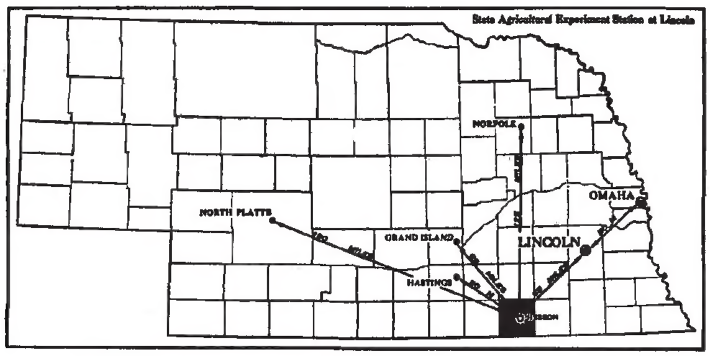

Figure 1.—**Location of Thayer County in Nebraska.**

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Thayer County, where they are located, and how they can be used. They went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Crete and Hastings, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape.

Many soil series contain soils that differ in the texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Hastings silt loam and Hastings silty clay loam are two soil types in the Hastings series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Hastings silt loam, 3 to 7 percent slopes, is one of several phases of Hastings silt loam.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in

planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. Such a mixture of soils is shown on the map as one mapping unit and is called a soil complex. Ordinarily, a complex is named for the major kinds of soil in it, for example, Jansen-Meadin complex, 5 to 11 percent slopes. Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that may occur together without regularity in pattern or relative proportion. The individual tracts of the component soils could be shown separately on the map, but the differences between the soils are so slight that the separation is not important for the objectives of the soil survey. An example is Wakeen and Kipp silty clay loams, 7 to 11 percent slopes.

Most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units, but they are given descriptive names, such as Sandy alluvial land, and are called land types.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil surveys. On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust them according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Thayer County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

In this county there are six associations. Figures 2 and 3 show in a general way the relationship of the major soil series to topography and parent material. The six associations are discussed in the following pages.

1. Hastings-Geary association

Deep, strongly sloping, silty soils on uplands

This association consists of strongly sloping to steep, dark-colored soils that developed in loess. It occurs on side slopes along intermittent upland streams, mainly in the western half of the county. The total area is about 49,000 acres, or slightly more than 13 percent of the county. About 64 percent of this consists of Hastings soils, about 31 percent of Geary soils, and the rest mainly of Jansen and Meadin soils.

Hastings soils have a surface layer of very dark brown silt loam in uneroded areas and of dark-brown silty clay loam in eroded areas. Their subsoil is dark-brown silty clay loam. The underlying material is light yellowish-brown, calcareous loess of silt loam texture.

Geary soils have a surface layer of very dark brown light silty clay loam. Their subsoil is dark-brown to yellowish-red silty clay loam that grades to a more reddish color as depth increases. The underlying material is yellowish red, generally noncalcareous loess of silty clay loam texture. Geary soils are more strongly sloping than Hastings soils but are at lower elevations.

Jansen and Meadin soils occur on the lower part of side slopes. Jansen soils are moderately deep over sand and gravel. Meadin soils are shallow over sand and gravel.

The dominant soils of this association, the Hastings and Geary, are moderately slowly permeable. Their surface layer is slightly acid to medium acid, and their subsoil is slightly acid to neutral. Their substrata are slightly alkaline; they contain moderate amounts of lime.

About half of this association is cultivated, and about half is used as native pasture. Wheat, grain sorghum, and alfalfa are the main crops. The cultivated areas have lost most of their surface layer through erosion. Irrigation is not practical, because of the slope. The main limitations are a low content of organic matter and the hazard of erosion. Most of the farms are a combination of the cash-grain and general livestock types. Nearly level or gently sloping soils of other associations occur on most farms. Farm-to-market roads reach all points of this association.

2. Hobbs-Muir-Cass association

Deep, nearly level, silty soils on benches and bottom lands

This association consists of nearly level, dark-colored soils that developed in alluvium. It is in stream valleys, where it occupies bottom lands, stream terraces, and foot slopes. Areas on bottom lands are flooded for short periods after heavy rains. The total area is about 51,000 acres, or nearly 14 percent of the county. About 46 percent of this consists of Hobbs soils, 25 percent of Muir soils, 27 percent of Cass soils, and the rest of Detroit and Lamo soils.

Hobbs soils and Muir soils have a thick surface layer of very dark grayish-brown loam, silt loam, or light silty clay loam that grades to dark brown as depth increases. The underlying material, to a depth of 5 feet or more, is dark-brown, noncalcareous alluvium of silt loam texture.

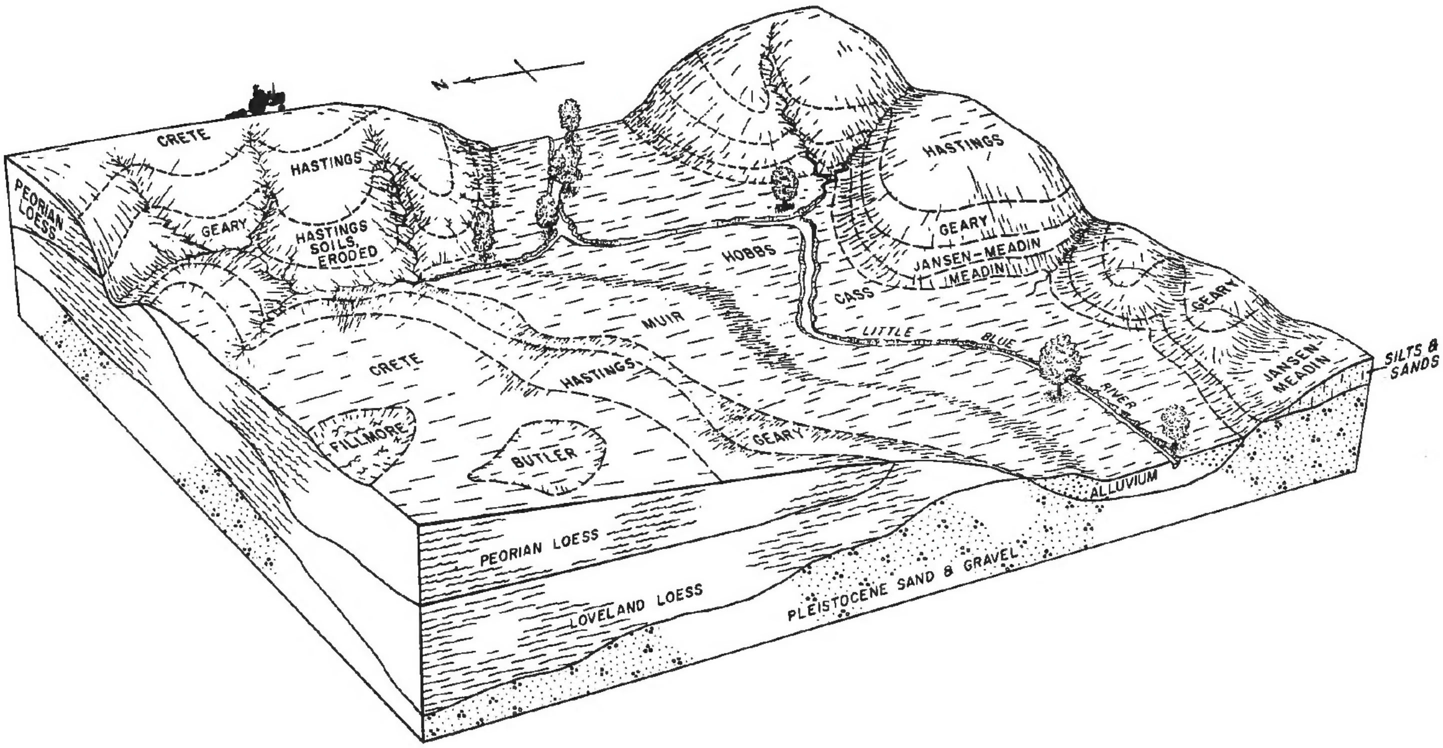

Figure 2.—**Pattern of soil series typical of associations 1, 2, 3, and 4.**

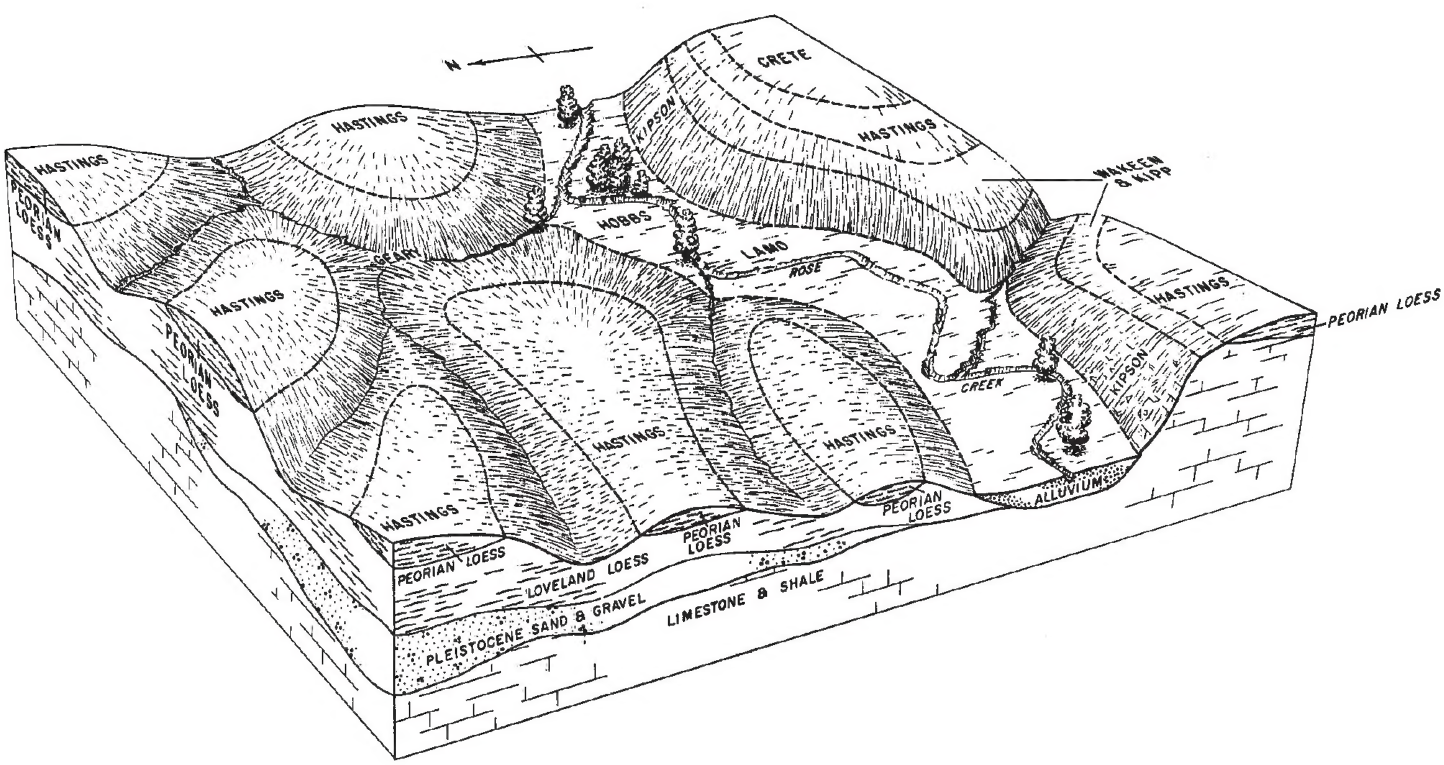

Figure 3.—**Pattern of soil series typical of associations 5 and 6.**

Hobbs soils occupy lower positions than Muir soils and are flooded occasionally. Muir soils occupy higher terraces and are not flooded.

Cass soils have a surface layer of very dark brown silt loam or fine sandy loam. Their subsoil consists of stratified, light-colored fine sandy loam that contains a few lenses of silt or coarser sand. The underlying material is sandy alluvium mottled with rust brown. Stratification is less discernible as depth increases. Most areas of these soils are flooded when the larger streams overflow. The water table is usually at a depth of 5 to 7 feet.

Detroit soils, which occur on stream terraces, are well drained. Lamo soils, which occur on bottom lands, are somewhat poorly drained.

The soils in this association have a medium to high content of organic matter. Generally, they are well drained. They absorb moisture readily and store it well. They are easily tilled.

About 85 percent of this association is cultivated, and the rest is grassland or wooded areas along streams. The farms are generally a combination of the cash-grain and general livestock types. Except along the Little Blue River, roads run along most section lines.

3. Crete-Hastings-Butler association

Deep, nearly level soils that have a silty surface layer and a clayey subsoil; on uplands

This association consists of nearly level to sloping, dark-colored soils that developed in loess. These are the dominant soils of the uplands. The total area is about 192,000 acres, or nearly 52 percent of the county. About 59 percent of this consists of Crete soils, about 35 percent of Hastings soils, 5 percent of Butler soils, and the rest of Fillmore and Scott soils.

Crete soils have a surface layer of very dark brown silt loam. The upper part of their subsoil is dark-brown silty clay or clay. The lower part is yellowish-brown, calcareous silty clay loam. The underlying material is light yellowish-brown, calcareous loess of silt loam texture.

Hastings soils have a surface layer of very dark brown silt loam. Their subsoil is dark-brown silty clay loam that grades to lighter brown as depth increases. It is more friable and less clayey than the subsoil of Crete soils. The underlying material is light yellowish-brown, calcareous loess of silt loam texture.

Butler soils have a surface layer of very dark brown silt loam or silty clay loam. A thin layer of grayish, leached material occurs as a subsurface layer just above the upper boundary of the subsoil. The subsoil is compact, black silty clay or clay. The underlying material is olive-gray to light brownish-gray, calcareous loess of silt loam texture.

Fillmore and Scott soils occur in depressions.

The sloping areas of Crete and Hastings soils are susceptible to erosion. They absorb water slowly and are somewhat droughty during periods of low rainfall. Permeability is slow to moderately slow in the subsoil.

Most of this association is cultivated. Nearly 90 percent of the county's irrigated acreage is in this association. Deep wells supply the water. The principal dryland crops are wheat and grain sorghum. The principal irrigated crops are grain sorghum and corn. Nearly all of the farms are of the cash-grain type. There are some general livestock farms in strongly sloping and steep areas. Gravel roads run along most section lines.

4. Jansen-Meadin association

Moderately sloping to strongly sloping soils that are moderately deep or shallow to gravel; on uplands

This association consists principally of moderately sloping and strongly sloping, dark-colored soils that developed in loess overlying mixed sand and gravel. These soils occur mainly on valley side slopes along the Little Blue River, Dry Creek, and Big Sandy Creek and, in the eastern part of the county, along intermittent drainageways leading into those streams. The topography is irregular. There are many uncrossable gullies entrenched in the hillsides. The total area is about 25,000 acres, or nearly 7 percent of the county. About 80 percent of this consists of Jansen soils, about 18 percent of Meadin soils, and the rest of Geary soils.

Jansen soils are noncalcareous. They are mainly very dark brown or dark brown silty clay loam, but in places they are loam or fine sandy loam. They are 10 to 36 inches deep over mixed sand and gravel.

Meadin soils have a very dark grayish-brown surface layer. In most places the texture of their surface layer is loam, but in a few places it is sandy loam. These soils are 10 to 20 inches thick over mixed sand and gravel.

Geary soils are mainly on gently sloping ridgetops between intermittent streams.

The soils in this association are low in content of organic matter. They have a low moisture-holding capacity. They are easily eroded because of the slope.

About 40 percent of this association is cultivated, although the soils are not particularly well suited to the common crops. The rest is grassland or wooded areas along intermittent streams. The main problems are the conservation of moisture and the control of erosion.

There are a few general livestock farms in this association. Some of the farms include areas of the Geary-Hastings association.

5. Geary-Hastings association

Deep, moderately sloping to strongly sloping, silty soils on uplands

This association consists of gently sloping to strongly sloping, dark-colored soils that developed in loess. These soils occur on side slopes and ridgetops, mainly in the southeastern part of the county north of Rose Creek. The total area is about 47,000 acres, or nearly 13 percent of the county. About 76 percent of this consists of Geary soils and about 24 percent of Hastings soils.

Geary soils occur on strongly sloping side slopes. They have a surface layer of very dark brown light silty clay loam. Their subsoil is dark-brown to yellowish-red silty clay loam that grades to a more reddish color as depth increases. The underlying material is generally noncalcareous, yellowish-red loess of silty clay loam texture.

Hastings soils occur on gently sloping ridgetops. They have a surface layer of very dark brown silt loam and a subsoil of dark brown silty clay loam. The underlying material is calcareous, light yellowish-brown loess of silt loam texture.

Soils of other series occupy a minor acreage in this association. Among these are Hobbs soils in upland draws. Hobbs soils are occasionally flooded after rains.

About 85 percent of this association is cultivated, and 15 percent is in native grassland. Irrigation is not practical, because the slopes are too strong. The main problems are the control of runoff and erosion.

Most of the farms in this association are a combination of the cash-grain and general livestock types. Farm-to-market roads reach all points in this association.

6. Kipson-Wakeen association

Shallow and moderately deep, steep soils overlying limestone; on uplands

This association consists of strongly sloping to steep, dark-colored soils that developed partly in material weathered from limestone and limy shale and partly in thin deposits of loess. These soils occur mainly in the southeastern part of the county, on north-facing valley side slopes along Rose Creek and its tributaries. A smaller area occurs on steep side slopes in the east-central part of the county, south of the Little Blue River. The total area is about 5,000 acres, or slightly more than 1 percent of the county. About 63 percent of this consists of Kipson soils, and the rest of Wakeen soils.

Kipson soils are shallow, and most of the acreage is steep. They have a surface layer of very dark grayish-brown, calcareous silty clay loam. The underlying bedrock is medium soft, gray to very pale brown, interbedded limestone and limy shale. The upper part of the substratum is sufficiently fragmented to be penetrated by roots.

Wakeen soils are moderately deep. They have a very dark grayish-brown surface layer. In most places this layer is silty clay loam, but in a few places it is silt loam. The subsoil is generally silty clay loam, but in places the upper part is dark-brown silty clay that grades to light yellowish brown in the lower part. The underlying bedrock is like that of the Kipson soils. Small fragments of limestone occur throughout the profile.

Most of this association is in native grassland. The main problems are the conservation of moisture and the control of erosion.

Nearly all of the farms are a combination of the general livestock and cash-grain types. Most include areas of nearly level bottom land or flat uplands. There are roads along some, but not all, section lines.

Descriptions of the Soils

This section describes the soil series and mapping units of Thayer County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

In the pages that follow, a general description of each soil series is given. Each series description includes a detailed description of a profile representative of the series and, generally, a brief statement of the range in characteristics of the soils in the series, as mapped in this county. Following the series description, each mapping unit in the series is described individually. For full information on any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit. Miscellaneous land types, such as Sandy alluvial land, are described in alphabetic order along with the soil series.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Breaks-Alluvial land complex	4,982	1.3
Butler silt loam	7,442	2.0
Cass very fine sandy loam (occasionally flooded)	4,991	1.3
Cass fine sandy loam (occasionally flooded)	1,172	.3
Crete silt loam, 0 to 1 percent slopes	97,063	26.3
Crete silt loam, 1 to 3 percent slopes	13,793	3.7
Crete silty clay loam, 3 to 7 percent slopes, eroded	962	.3
Detroit silt loam	1,557	.4
Fillmore silt loam	2,015	.5
Geary silty clay loam, 3 to 7 percent slopes, eroded	6,541	1.8
Geary silty clay loam, 7 to 11 percent slopes, eroded	7,400	2.0
Geary silty clay loam, 7 to 11 percent slopes, severely eroded	19,047	5.2
Geary silty clay loam, 11 to 30 percent slopes	14,341	3.9
Geary silty clay loam, 11 to 30 percent slopes, severely eroded	3,938	1.1
Hastings silt loam, 0 to 1 percent slopes	5,878	1.6
Hastings silt loam, 1 to 3 percent slopes	29,963	8.1
Hastings silt loam, 3 to 7 percent slopes	3,438	.9
Hastings silt loam, 7 to 11 percent slopes	3,525	1.0
Hastings silty clay loam, 0 to 1 percent slopes	991	.3
Hastings silty clay loam, 3 to 7 percent slopes, eroded	42,114	11.4
Hastings silty clay loam, 7 to 11 percent slopes, eroded	1,061	.3
Hastings soils, eroded	18,555	5.0
Hobbs silt loam, seldom flooded	16,945	4.6
Hobbs silt loam, occasionally flooded	11,710	3.2
Hobbs silt loam, 1 to 4 percent slopes	5,031	1.4
Jansen loam, 7 to 11 percent slopes	810	.2
Jansen sandy clay loam, 7 to 11 percent slopes, eroded	686	.2
Jansen-Meadin complex, 5 to 11 percent slopes	2,939	.8
Jansen-Meadin complex, 5 to 11 percent slopes, eroded	5,251	1.4
Jansen-Meadin complex, 11 to 30 percent slopes	7,434	2.0
Jansen-Meadin complex, 11 to 30 percent slopes, eroded	1,765	.5
Kipson soils, 11 to 30 percent slopes	3,340	.9
Lamo silty clay loam	1,432	.4
Lamo silty clay loam, drained	930	.2
Lancaster loam, 7 to 16 percent slopes, severely eroded	288	.1
Meadin loam, 3 to 30 percent slopes	4,354	1.2
Muir silt loam, 0 to 1 percent slopes	5,454	1.5
Muir silt loam, 1 to 3 percent slopes	950	.2
Muir silt loam, 3 to 7 percent slopes, eroded	293	.1
Muir-Meadin complex, 0 to 3 percent slopes	1,509	.4
Sandy alluvial land	302	.1
Scott soils	259	.1
Silty alluvial land	4,122	1.1
Wakeen silty clay loam, 11 to 30 percent slopes	364	.1
Wakeen and Kipp silty clay loams, 7 to 11 percent slopes	943	.2
Wakeen and Kipp silty clay loams, 7 to 11 percent slopes, severely eroded	365	.1
Streams and ponds	951	.3
Gravel pits and quarries	84	(1)
Total	369,280	100.0

[1] Less than 0.10 percent.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At the end of the description of each mapping unit are listed the capability unit, the range

site, and the windbreak group in which the mapping unit has been placed. The page where each of these groups is described can be found readily by referring to the "Guide to Mapping Units" at the back of this publication.

For more general information about the soils, the reader can refer to the section "General Soil Map," in which the broad patterns of soils are described. Many of the terms used in the soil descriptions and other parts of the report are defined in the Glossary.

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (By) occurs along large upland drainageways. About 65 to 75 percent of it consists of immature soils that formed in pale-brown to yellowish-brown loess. These areas are strongly sloping. The rest of the complex consists of deep, dark-colored, silty sediments that have accumulated on narrow, nearly level bottom lands that are flooded occasionally.

The vegetation on the side slopes consists of grasses interspersed with trees. That on the bottom lands consists of grasses, tall annual weeds, trees, and woody shrubs. Although this land type is not suitable for cultivation, a few small areas have been cultivated. These areas should be returned to native grasses. (Both parts in dryland capability unit VIe–1; Breaks in Silty range site, and Alluvial land in Silty Overflow range site; both parts in Silty to Clayey windbreak group)

Butler Series

The Butler series consists of deep, dark-colored, somewhat poorly drained soils that have a claypan. These soils developed in silty, calcareous loess. They occur near the heads of upland drainageways, as level areas or in slight depressions. They receive runoff from higher lying soils.

The surface layer is generally very dark brown silt loam 8 to 14 inches thick. It is neutral or slightly acid. A thin layer of grayish, leached material occurs at the boundary between the surface layer and the subsoil.

The subsoil is black or very dark brown silty clay or clay 16 to 30 inches thick. This layer is sticky when wet, compact when moist, and very hard when dry. It is neutral to slightly alkaline. Its structure is blocky. The upper part of the subsoil contains fibrous roots, but only the larger taproots penetrate the lower part.

The underlying material is olive-gray to light brownish-gray, silty, calcareous loess. This material grades to light yellowish-brown silty loess at a depth of 60 to 84 inches.

Butler soils respond well to irrigation. Most of the acreage is cultivated.

In this county, Butler soils are associated with Scott, Fillmore, and Crete soils. They are intermediate in drainage between the better drained Crete soils and the more poorly drained Fillmore soils. They occur at higher elevations than Fillmore soils, and they lack the grayish cast that is characteristic of freshly cultivated areas of those soils. Butler soils have a thicker surface layer than Scott soils, and their subsurface layer of leached material is less prominent than that of those soils.

Typical profile of Butler silt loam, in a pasture of tame grasses 0.35 mile east and 50 feet south of the northwest corner of sec. 26, T. 4 N., R. 4 W.

Ap—0 to 5 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, friable when moist; pH 6.8; abrupt, smooth boundary.

A1—5 to 10 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, friable when moist; pH 6.8; abrupt, smooth boundary.

A2—10 to 12 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium and fine, subangular blocky; slightly hard when dry, friable when moist; pH 6.8; abrupt, smooth boundary.

B21t—12 to 23 inches, dark-gray (10YR 4/1) clay; very dark brown (10YR 2/2) when moist; strong, coarse, prismatic structure breaking to strong, medium, blocky; very hard when dry, very firm when moist; pH 7.6; gradual, smooth boundary.

B22t—23 to 28 inches, dark-gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) when moist; strong, coarse, prismatic structure breaking to strong, medium, blocky; very hard when dry, very firm when moist; pH 7.8; clear, smooth boundary.

B3ca—28 to 36 inches, dark-gray (10YR 4/1) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, prismatic structure breaking to moderate, medium and coarse, subangular blocky; hard when dry, firm when moist; pH 8.2; strongly effervescent; gradual, smooth boundary.

C1—36 to 50 inches, gray (5Y 5/1) silt loam, dark olive gray (5Y 3/2) when moist; moderate, coarse, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry, friable when moist; pH 8.6; gradual, smooth boundary.

C2—50 to 62 inches, gray (5Y 6/1) silt loam, olive gray (5Y 5/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; pH 8.2; gradual, smooth boundary.

C3—62 to 72 inches, light-gray (5Y 7/1) silt loam, light olive gray (5Y 6/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; few to common, medium, distinct iron stains; pH 8.2.

The texture of the subsoil is clay, silty clay, or silty clay loam. The clay content ranges from 45 to 55 percent. The depth to lime ranges from 30 to 50 inches.

Butler silt loam (Bu).—This soil occurs as level areas or in slight depressions. The slope is less than 1 percent. Runoff from adjacent areas stands on this soil for short periods. As much as 15 percent of some areas consists of Fillmore soils, which are easily recognizable in freshly cultivated fields by their grayish cast.

This soil puddles readily if it is worked or grazed when wet. If properly managed, however, it can be kept in good condition. It is droughty because the subsoil is clayey.

Most of this soil is cultivated. Wheat and grain sorghum are the principal dryland crops, and corn and grain sorghum the principal irrigated crops. (Dryland capability unit IIw–2; irrigated capability unit IIs–2; Clayey range site; Silty to Clayey windbreak group)

Cass Series

The Cass series consists of deep, moderately dark colored, loamy soils that have a sandy subsoil. These soils developed in recent alluvium. They occur mainly on low bottom lands along perennial streams in the central part of the county. Ground water is at a depth of 5 to 10 feet.

The surface layer is very dark grayish-brown fine sandy loam or silt loam. It is friable when moist and is neutral to slightly acid.

A transitional layer, 4 to 9 inches thick, occurs between the surface layer and the underlying material. This layer consists of friable fine sandy loam of about the same texture as the surface layer but somewhat lighter in color.

The subsoil and substratum consist of stratified, light-colored fine sandy loam that contains a few lenses of silt or coarser sand. As depth increases, this material grades to sandier, less stratified material that is mottled with rust brown.

These soils are moderately high in natural fertility. They are moderately low in moisture-holding capacity because the lower horizons are moderately sandy. They respond well to irrigation but are not extensively irrigated, because of the overflow hazard. The response to fertilizer is good.

Grain sorghum and corn are the principal dryland crops. The native pasture stands are mainly bluegrass, but there is some bluestem and switchgrass and there are many annual weeds and forbs. Honeylocust, redcedar, and other woody plants are common in areas that are flooded occasionally. Except for wooded pastureland bordering streams, most of the acreage is cultivated.

In this county, Cass soils are associated with Hobbs and Lamo soils. The Hobbs soils have a silty subsoil and substratum. The Lamo soils have a clayey subsoil, and their water table is moderately high.

Typical profile of Cass very fine sandy loam, in a field of winter wheat 0.2 mile north and 50 feet west of the southeast corner of sec. 23, T. 3 N., R. 4 W.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; pH 6.8; noncalcareous; abrupt, smooth boundary.

A12—6 to 10 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure breaking to weak, medium, granular; slightly hard when dry, friable when moist; pH 6.8; noncalcareous; clear, smooth boundary.

AC—10 to 16 inches, grayish-brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure breaking to weak, fine, subangular blocky; slightly hard when dry, very friable when moist; pH 6.8; noncalcareous; gradual, smooth boundary.

C1—16 to 28 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure breaking to single grain; slightly hard when dry, very friable when moist; pH 7.0; noncalcareous; gradual, smooth boundary.

C2—28 to 42 inches +, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; single grain; soft when dry, loose when moist; pH 7.0; noncalcareous.

The depth to the sandy subsoil or substratum ranges from 12 to 20 inches. Frequency of flooding of any given area depends on the elevation above the stream channel. Free lime occurs in a few profiles.

Cass very fine sandy loam (occasionally flooded) (Cv).—The surface layer of this soil consists of 8 to 12 inches of very fine sandy loam that is very friable and is easily tilled. This soil is flooded once or twice a year in about 3 out of 5 years. Crops are damaged both by the water itself and by the silt it deposits as it recedes. Included in the areas mapped are small areas of fine sandy loam.

This soil has moderately low moisture-holding capacity in the subsoil. Permeability is moderately rapid.

Grain sorghum, corn, and alfalfa are the principal crops. Wheat is not grown extensively, because of the hazard of flooding in spring. Crops respond well to irrigation. Most of the acreage is cultivated. (Dryland capability unit IIw–3; irrigated capability unit I–1; Sandy Lowland range site; Moderately Wet windbreak group.)

Cass fine sandy loam (occasionally flooded) (Cs).—This soil is on low bottom lands where the slope ranges from nearly level to undulating. It is flooded once or twice a year in about 3 out of 5 years. Included in the areas mapped are small areas of loamy sand.

This soil has moderately low moisture-holding capacity. Permeability is moderately rapid in the subsoil. Natural fertility is low. The organic-matter content is moderate. Wind erosion is a hazard, and a cropping system that keeps a cover on the soil most of the year is needed.

Grain sorghum, corn, and alfalfa are the main crops. Wheat is not grown extensively, because of the flood hazard. Nitrogen and phosphorus are needed. About half the acreage is used for pasture, and the other half is cultivated. (Dryland capability unit IIw–6; irrigated capability unit IIe–3; Sandy Lowland range site; Moderately Wet windbreak group.)

Crete Series

The Crete series consists of nearly level to gently sloping upland soils that have a claypan (fig. 4). These soils developed in medium-textured loess. The native vegetation consisted mainly of tall and mid grasses.

The surface layer is very dark brown silt loam about 11 inches thick. It has granular structure and is neutral or slightly acid. Roots are abundant in the surface layer in areas where the soil has a cover of native vegetation. In eroded areas the surface layer is silty clay loam.

The subsoil extends to a depth of about 34 inches. The upper part of the subsoil is dark-brown, noncalcareous silty clay or clay. It is very hard when dry and has prismatic structure. The prisms break readily to blocks, which are coated with clay. The lower part of the subsoil is yellowish-brown, calcareous silty clay loam that is stained with rusty brown in scattered places. This part of the subsoil contains soft, finely divided particles of lime and many hard concretions. The zone of lime accumulation is generally at a depth of 30 inches.

The underlying material is light yellowish-brown, calcareous silt loam that extends to a depth of 5 feet or more.

These soils are moderate to high in natural fertility. They absorb water slowly because of the claypan, and consequently they are somewhat droughty. They respond well to irrigation.

Most of the acreage of these soils is cultivated. They are the soils most extensively irrigated. Grain sorghum and corn are the principal irrigated crops, and wheat and grain sorghum are the principal dryland crops. These soils are suitable for growing trees for windbreaks, but they are not suitable for commercial production of trees. Small areas are still in native pasture, mainly western wheatgrass and buffalograss. Most of the pasture is overgrazed.

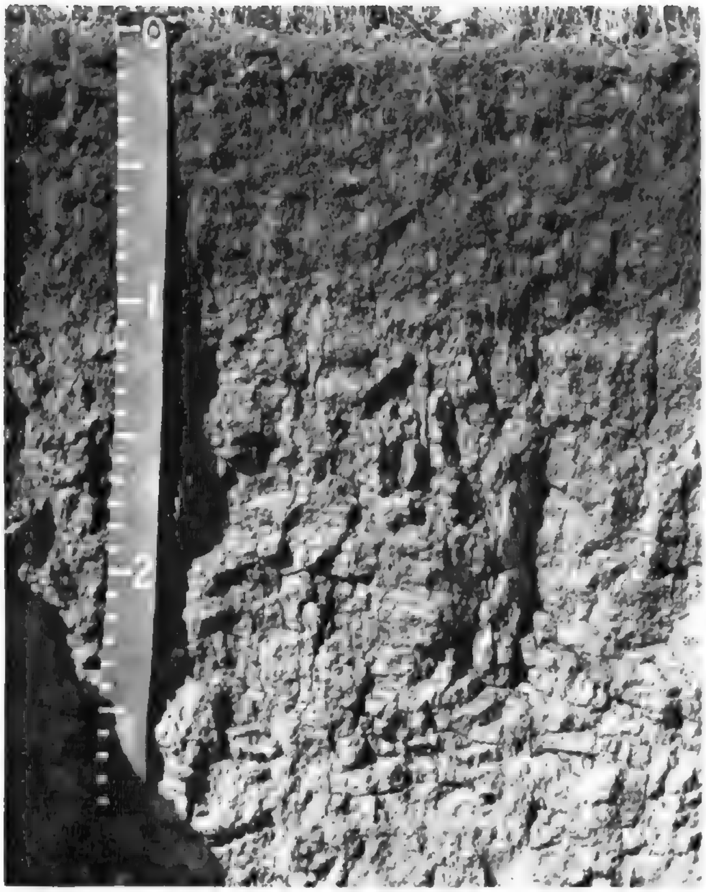

Figure 4.—Profile of Crete silt loam.

In this county, Crete soils are associated with Hastings, Butler, and Fillmore soils. Their subsoil is more clayey than that of Hastings soils. It is dark brown, and that of Butler and Fillmore soils is black. Crete soils are better drained than Butler and Fillmore soils.

Typical profile of Crete silt loam, 0 to 1 percent slopes, in a cultivated field 0.2 mile north and 50 feet east of the southwest corner of sec. 17, T. 4 N., R. 1 W.

Ap—0 to 5 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; pH 6.4; abrupt, smooth boundary.

A12—5 to 10 inches, dark-gray (10YR 4/1) heavy silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, friable when moist; pH 6.4; clear, smooth boundary.

B1—10 to 13 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, subangular blocky; hard when dry, firm when moist; pH 6.6; clear, smooth boundary.

B21t—13 to 25 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) when moist; strong, coarse, prismatic structure breaking to strong, medium and coarse, blocky; very hard when dry, very firm when moist; pH 6.8; clear, smooth boundary.

B22t—25 to 29 inches, brown (10YR 5/3) silty clay, dark yellowish brown (10YR 4/3.5) when moist; strong, coarse, prismatic structure breaking to strong, medium, blocky; very hard when dry, very firm when moist; pH 7.4; clear, smooth boundary.

B3ca—29 to 35 inches, pale-brown (10YR 6/3) silty clay loam, yellowish brown (10YR 5/4) when moist; moderate, coarse, prismatic structure breaking to strong, medium, subangular blocky; slightly hard when dry, firm when moist; pH 7.6; strongly effervescent; clear, smooth boundary.

C—35 to 52 inches +, very pale brown (10YR 7/3) silt loam, light yellowish brown (10YR 6/4) when moist; weak, coarse, prismatic structure to massive; slightly hard when dry, friable when moist; pH 8.2; strongly effervescent.

The thickness of the surface layer ranges from 8 to 13 inches. The texture of the subsoil is silty clay loam, silty clay, or clay. The clay content ranges from 45 to 52 percent. The clay coating on the vertical and horizontal faces of the peds is generally darker than the crushed color.

Crete silt loam, 0 to 1 percent slopes (Ce).—This soil is nearly level, but the areas mapped include small depressions occupied by Butler and Fillmore soils. These inclusions are shown on the soil map by depression symbols.

Yields of dryland crops are reduced in years when rainfall is below average. Wheat and sorghum do better than corn. All crops, and especially corn, respond well to irrigation, and row crops can be grown year after year under irrigation, if plant residue is returned and fertility is maintained. Nitrogen and phosphorus are needed. This soil puddles readily if worked or trampled when wet, but if well managed, it can be kept in good condition. (Dryland capability unit IIs–2; irrigated capability unit IIs–2; Clayey range site; Silty to Clayey windbreak group)

Crete silt loam, 1 to 3 percent slopes (CeA).—This soil has a claypan. In most places the surface layer is 7 to 11 inches thick. The hazard of erosion is slight to moderate.

Wheat, grain sorghum, and alfalfa are the principal dryland crops, and corn and grain sorghum are the principal irrigated crops. Crops respond well to irrigation. Fertilizer is needed. Terraces and grassed waterways are needed to control erosion and conserve moisture. About 10 percent of the acreage is cultivated, and the rest is in native grasses. (Dryland capability unit IIe–2; irrigated capability unit IIIe–2; Clayey range site; Silty to Clayey windbreak group)

Crete silty clay loam, 3 to 7 percent slopes, eroded (CrB2).—This soil has a surface layer that is 4 to 7 inches thick in most places. It is generally moderately eroded, but a few spots are severely eroded and now have a light-colored surface layer. As much as 15 percent of some areas mapped consists of Hastings soils.

Wheat, grain sorghum, corn, and alfalfa are the principal dryland crops. Small acreages of corn and grain sorghum are grown under irrigation. Fertilizer is needed. Terraces, contour farming, and grassed waterways are needed to control erosion and conserve moisture. Most of the acreage is cultivated. (Dryland capability unit IIIe–2; irrigated capability unit IIIe–2; Clayey range site; Silty to Clayey windbreak group)

Detroit Series

The Detroit series consists of deep, dark-colored soils that developed in silty alluvium or in a mixture of alluvium and loess. These soils occur mainly as nearly level terraces in the valley of the Little Blue River and along other perennial streams. The soils on the lower terraces show some stratification. The soils on the higher terraces are those that formed partly in loess. Some areas of these soils

occur as slight depressions. The native vegetation consisted of grasses and scattered trees.

The surface layer is very dark brown to very dark grayish-brown silt loam 8 to 18 inches thick. It is friable when moist and is easily worked. It is slightly acid or neutral.

The subsoil consists of 8 to 22 inches of very dark grayish-brown to dark grayish-brown silty clay loam. It is moderately compact and has subangular blocky structure.

On the lower terraces, the underlying material consists of 5 feet or more of dark grayish-brown, noncalcareous, silty alluvium. On the higher terraces, the material below a depth of 3 feet is a mixture of brown, calcareous alluvium and loess.

The Detroit soils are moderate to high in natural fertility. They absorb moisture readily and retain a good supply. The principal cultivated crops are grain sorghum, corn, wheat, and alfalfa. The principal pasture plants are big bluestem, little bluestem, indiangrass, switchgrass, sideoats grama, and western wheatgrass. Most of the acreage is cultivated.

Detroit soils are associated mainly with Muir soils. They have a more clayey, less friable subsoil than those soils.

Typical profile of Detroit silt loam, 0.2 mile north and 50 feet east of the southwest corner of sec. 3, T. 2 N., R. 2 W.

Ap—0 to 5 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, very friable when moist; pH 6.6; noncalcareous; abrupt, smooth boundary.

A1—5 to 13 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, platy structure breaking to moderate, medium, granular; slightly hard when dry, very friable when moist; pH 6.6; noncalcareous; clear, smooth boundary.

B1—13 to 16 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; pH 6.8; noncalcareous; clear, smooth boundary.

B2t—16 to 28 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark brown (10YR 3/3) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 7.2; noncalcareous; clear, smooth boundary.

B3—28 to 32 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; pH 7.4; slightly effervescent; clear, smooth boundary.

C—32 to 48 inches +, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, very friable when moist; pH 7.6; noncalcareous.

The texture of the surface layer is predominantly silt loam, but in places it is silty clay loam. A dark-colored buried soil occurs in some places. The depth to the buried soil varies from place to place.

Detroit silt loam (De).—This soil is nearly level. Permeability is moderately slow, and the moisture-holding capacity is high. As much as 10 percent of some of the areas mapped consists of Muir soils.

This soil is well suited to cultivated crops, and some of the acreage is irrigated. Crop residue can be utilized to improve tilth and conserve moisture. Nitrogen and phosphorus are needed.

Grain sorghum, wheat, corn, and alfalfa are the most common dryland crops, and grain sorghum and corn the most common irrigated crops. (Dryland capability unit I-1; irrigated capability unit I-1; Silty Lowland range site; Silty to Clayey windbreak group)

Fillmore Series

The Fillmore series consists of deep, dark-colored, somewhat poorly drained soils that have a claypan. These soils developed in loess. They occur on uplands as shallow basins or depressions and receive runoff from surrounding soils.

The surface layer is dark-gray silt loam 8 to 12 inches thick. It is slightly acid to neutral. It is underlain by a stratum of light-gray silt loam that varies from just a speckling to a distinct layer 1 or 2 inches thick. Grass roots are abundant in areas used for pasture.

The subsoil consists of 18 to 32 inches of silty clay or clay that is very dark brown to very dark gray or black when moist. It is sticky and plastic when wet and very hard when dry. It is slightly acid to neutral. Grass roots decrease in number with depth. The boundary between the subsoil and the overlying subsurface layer is abrupt in most places.

In most places the substratum is grayish-brown to olive-gray silt loam that is somewhat mottled in the upper part. It is neutral to moderately alkaline and contains free lime in most places.

Runoff from surrounding areas stands on these soils until it either evaporates or is absorbed, since few of the depressions have natural drainage outlets. Fertility is moderately low. Most of the acreage is cultivated.

Grain sorghum and wheat are the principal dryland crops. Corn and alfalfa are not grown extensively, because of a hazard of flooding in spring. Crops respond well in irrigated areas. Fertilizer is needed. The principal pasture plants are western wheatgrass, annual grasses, and weeds.

Fillmore soils are associated with Scott and Butler soils, which occupy similar topographic positions, and with Crete soils. They have a thicker surface soil than Scott soils and are better drained than those soils. When freshly cultivated, Fillmore soils have a characteristic grayish cast, which distinguishes them from Butler soils. They are more poorly drained than Butler soils and have a more distinct subsurface layer of gray material. They occur at lower elevations than Crete soils. They have a very dark brown to black subsoil, unlike the dark-brown subsoil of Crete soils.

Typical profile of Fillmore silt loam, in a cultivated field 0.3 mile west and 100 feet north of the southeast corner of sec. 21, T. 3 N., R. 2 W.

Ap—0 to 5 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure breaking to weak, fine, crumb; soft when dry, very friable when moist; pH 6.8; noncalcareous; abrupt, smooth boundary.

A1—5 to 10 inches, gray (10YR 5/1) silt loam, dark gray (10YR 4/1) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, friable when moist; pH 6.4; noncalcareous; clear, smooth boundary.

A2—10 to 12 inches, light-gray (10YR 7/1) silt loam, gray (10YR 5/1) when moist; weak, medium, subangular blocky structure breaking to weak, fine, subangular blocky; soft when dry, very friable when moist; pH 6.8, noncalcareous; abrupt, smooth boundary.

B21t—12 to 22 inches, grayish-brown (10YR 5/2) silty clay, very dark brown (10YR 2/2) when moist; strong, coarse, blocky structure breaking to strong, medium, blocky; very hard when dry, very firm when moist; pH 7.2; noncalcareous; clear, smooth boundary.

B22t—22 to 30 inches, grayish-brown (10YR 5/2) silty clay, very dark gray (10YR 3/1) when moist; strong, coarse, blocky structure breaking to strong, medium, blocky; very hard when dry, very firm when moist; pH 7.6; noncalcareous; clear, smooth boundary.

B3—30 to 44 inches, grayish-brown (10YR 5/2) silty clay loam, very dark gray (10YR 3/1) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 7.6; strongly effervescent; few, medium, distinct, hard concretions of lime; few medium concretions of iron; gradual, smooth boundary.

C—44 to 72 inches, pale-brown (10YR 6/3) silt loam, grayish brown (2.5Y 5/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; pH 7.8; strongly effervescent; common, medium, prominent iron stains; common, fine, faint concretions of lime.

The depth to lime ranges from 30 to 48 inches.

Fillmore silt loam (Fm).—This soil is in depressions. The slope is less than 1 percent. As much as 15 percent of some of the areas mapped consists of Butler soils.

Water stands on this soil for periods of several days to 2 weeks after heavy rain. The surface puddles readily if the soil is worked or grazed when wet. When dry, the puddled soil hardens and is difficult to work.

Most of this soil is cultivated. Some areas can be irrigated if drained and graded. Grain sorghum and wheat are the principal dryland crops, and corn and grain sorghum the principal irrigated crops. Nitrogen and phosphorus are needed. Surface drainage is beneficial, and surface planting of row crops decreases the risk of loss of a crop through flooding. (Dryland capability unit IIIw–2; irrigated capability unit IIs–2; Clayey Overflow range site; Moderately Wet windbreak group)

Geary Series

The Geary series consists of loamy soils that developed in moderately thick deposits of reddish-brown to yellowish-red, moderately fine textured loess. Geary soils are gently sloping to moderately steep. They are extensive in the southeastern part of the county, between Gilead and Hubbell. The native vegetation consisted mainly of mid and tall grasses, including big bluestem, little bluestem, and sideoats grama.

The surface layer is noncalcareous silty clay loam that is 10 to 16 inches thick where not eroded. This layer is dark gray when dry, and, in its natural state, is granular and friable when moist. Roots are abundant.

The subsoil consists of noncalcareous, compact silty clay loam. It ranges from 14 to 28 inches in thickness. The color grades from dark grayish brown in the upper part to reddish brown in the lower part. There are many grass roots in this layer, but they decrease in number with depth.

The underlying material is a moderately thick deposit of yellowish-red, generally noncalcareous loess of silty clay loam texture. This material is less compact than the subsoil. The upper part contains iron stains and a few small concretions of lime.

Surface runoff is moderately rapid to rapid, so crops do not get full benefit from the rainfall. The moisture-holding capacity is high enough, however, that moisture is available to plants during dry weather. Natural fertility is moderate to high in uneroded soils and low in eroded soils. The gently sloping soils are well suited to cultivation. Wheat, grain sorghum, and alfalfa are the principal dryland crops.

Geary soils are associated with Hastings and Jansen soils. They occur at lower elevations than Hastings soils, and their parent loess was more reddish than that of those soils. Their profile is more strongly developed than that of Jansen soils.

Typical profile of Geary silty clay loam, 7 to 11 percent slopes, in a field of native hay 100 feet west and 50 feet north of the southeast corner of sec. 31, T. 2 N., R. 1 W.

A1—0 to 12 inches, dark-gray (10YR 4/1) light silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, friable when moist; pH 6.4; noncalcareous; clear, smooth boundary.

B1—12 to 16 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, subangular blocky; slightly hard when dry, friable when moist; pH 6.6; noncalcareous; clear, smooth boundary.

B21t—16 to 26 inches, dark reddish-gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 6.6; noncalcareous; clear, smooth boundary.

B22t—26 to 32 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 6.8; noncalcareous; clear, smooth boundary.

B3—32 to 38 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 7.2; noncalcareous; clear, smooth boundary.

C1—38 to 60 inches, yellowish-red (5YR 5/6) light silty clay loam, reddish brown (5YR 4/4) when moist; moderate, coarse, prismatic structure, breaking to moderate, medium, subangular blocky; slightly hard when dry, friable when moist; pH 7.4; violently effervescent; common, medium, distinct, soft concretions of lime; gradual, smooth boundary.

C2—60 to 72 inches, reddish-yellow (5YR 6/6) light silty clay loam, yellowish red (5YR 4/6) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; pH 7.4; slightly effervescent.

The surface layer ranges from 5 to 12 inches in thickness. Some of the steep soils that developed entirely in the yellowish-red loess are immature and have a thinner surface layer and subsoil than other Geary soils. The material underlying Geary soils is dominantly silty clay loam, but in places this material is coarser textured.

Geary silty clay loam, 3 to 7 percent slopes, eroded (GeB2).—This soil is on ridge crests and gentle side slopes. In most places the surface layer is dark colored, but in some it has been severely eroded and consequently is light colored.

Terraces and waterways are needed to help conserve moisture and control erosion. The return of crop residue to the soil improves the moisture-holding capacity and helps to maintain the organic-matter content.

This soil is suited to nearly all the dryland crops commonly grown in the county. It can be irrigated if well managed. Most of the acreage is cultivated. (Dryland capability unit IIIe–1; irrigated capability unit IIIe–1; Silty range site; Silty to Clayey windbreak group)

Geary silty clay loam, 7 to 11 percent slopes, eroded (GeC2).—This soil is on hillsides and on the slopes along drainageways. In most places the surface layer is dark colored, but in more eroded areas it is thinner and lighter colored. Included in some of the areas mapped at the higher elevations are areas of eroded Hastings soils.

This soil is moderately low in fertility and is neutral or slightly acid. It puddles readily if it is worked or grazed when too wet. The organic-matter content is moderately low. Surface runoff is moderate to rapid, depending on the amount of vegetation and crop residue on the soil. Control of erosion and conservation of moisture are the main problems. The practices needed are terracing, contour farming, keeping grass in waterways, returning all crop residue to the soil, and applying fertilizer.

This soil is suited to close-growing crops and an occasional row crop. It is also suitable for seeding to native grasses. Most of the acreage is cultivated. (Dryland capability unit IVe–1; Silty range site; Silty to Clayey windbreak group)

Geary silty clay loam, 7 to 11 percent slopes, severely eroded (GeC3).—This soil is on side slopes along drainageways and on hillsides between drainageways. Erosion has removed most of the surface layer and in places part of the subsoil. The present surface layer is light-colored silty clay loam. In the many rills and crossable gullies the reddish-brown subsoil and the substratum are exposed. Included in the areas mapped are small areas of a severely eroded soil that formed in yellowish-brown loess.

This soil is low in natural fertility and in organic-matter content. The surface layer is moderately friable. Runoff is rapid because of the slope and the compact condition characteristic of the soil. The return of all crop residue and the addition of barnyard manure build up the organic-matter content and increase the moisture-holding capacity. Terracing, contour farming, keeping grass in waterways, and application of fertilizer are needed to control erosion and conserve moisture.

This soil is suited to wheat and grain sorghum and an occasional row crop. Yields are less than on soils having the same slope but a thicker and darker colored surface layer. Where native grasses have been seeded, they help to control erosion. (Dryland capability unit IVe–8; Silty range site; Silty to Clayey windbreak group)

Geary silty clay loam, 11 to 30 percent slopes (GeE).—This soil occurs on narrow side slopes along drainageways, on steep hills and bluffs, and in canyons. The surface layer is dark-brown to dark reddish-brown silty clay loam 5 to 8 inches thick. The subsoil is reddish-brown silty clay loam 7 to 12 inches thick. The surface layer and subsoil are thinner than in the profile described as typical of the series. The parent loess is exposed in some of the steeper areas; the slopes are not smooth, but have a catstep appearance. Slope ranges up to 45 percent but most commonly is about 25 percent.

As much as 25 percent of some of the areas mapped consists of loamy soils that developed in yellowish-brown loess. These areas are on the higher parts of strong slopes along drainageways. Sand and gravel crop out in small areas on the lower part of steep slopes. Small, narrow strips of a silty soil that formed in colluvium and alluvium occur on the bottoms of drainageways.

Most of the acreage is in native grasses and is used for pasture. The vegetation consists mainly of big bluestem, little bluestem, and sideoats grama. Oak trees and small shrubs grow on the steep slopes near the ends of drainageways. (Dryland capability unit VIe–1; Silty range site; Silty to Clayey windbreak group)

Geary silty clay loam, 11 to 30 percent slopes, severely eroded (GeE3).—This soil is on narrow side slopes along drainageways and on steep hills. Erosion has removed nearly all of the surface layer and much of the subsoil, and the parent material is exposed in many places. In most places the slope is about 16 percent. Gullies are numerous, and some of the larger ones cannot be crossed with farm machinery.

This soil is low in fertility and in organic-matter content. Surface runoff is moderately rapid to rapid, and infiltration of moisture is therefore less than on less sloping Geary soils.

This soil is not suited to cultivation but is suited to grass. It generally occurs as long, narrow strips that are difficult to manage separately. Plant residue and a vigorous stand of grasses help to maintain the supply of organic matter, to increase the moisture-holding capacity, and to control erosion. (Dryland capability unit VIe–8; Silty range site: Silty to Clayey windbreak group)

Hastings Series

The Hastings series consists of deep, well-drained, upland soils that developed in silty loess. These soils are nearly level to moderately sloping. The more sloping areas are slightly to moderately eroded. The native vegetation consisted mainly of mid and tall grasses.

The surface layer is dark-gray silt loam that is 8 to 12 inches thick where not eroded. This layer is very friable when moist. It is slightly acid to medium acid. In eroded areas the surface layer is lighter colored and is 5 to 10 inches thick.

The subsoil consists of 18 to 28 inches of brown, moderately compact silty clay loam that grades to lighter brown with depth. It is sticky when wet, firm when moist, and hard when dry. It has medium subangular blocky structure. Permeability is moderately slow.

The underlying material is silty loess that contains an abundance of lime. It is friable and easily penetrated by roots.

Hastings soils are suited to grain sorghum, wheat, corn, and alfalfa. They absorb moisture readily and retain a good supply. Natural fertility is moderately low to high. About 80 percent of the acreage is cultivated, and the rest is in native grasses. Nearly level and gently sloping areas are well suited to irrigation, if properly managed. The principal irrigated crops are corn and grain sorghum. The principal pasture plants are big bluestem, little bluestem, indiangrass, switchgrass, blue grama, and sideoats grama.

Hastings soils are associated with Crete and Geary soils. Their subsoil is less clayey and more permeable than that of Crete soils. They occur at higher elevations than Geary soils, which developed in more reddish loess.

Typical profile of Hastings silt loam, 3 to 7 percent slopes, in a pasture 0.23 mile west and 50 feet south of the northeast corner of sec. 33, T. 3 N., R. 4 W.

A1—0 to 11 inches, dark-gray (10YR 4/1) silt loam; very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; soft when dry, very friable when moist; pH 6.2; noncalcareous; clear, smooth boundary.

B1—11 to 13 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, subangular blocky; slightly hard when dry, friable when moist; pH 6.2; noncalcareous; clear, smooth boundary.

B21t—13 to 22 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 6.4; noncalcareous; clear, smooth boundary.

B22t—22 to 28 inches, brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 6.8; noncalcareous; clear, smooth boundary.

B3—28 to 33 inches, light yellowish-brown (10YR 6/4) light silty clay loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky; slightly hard when dry, friable when moist; pH 7.2; noncalcareous; clear, smooth boundary.

C—33 to 48 inches, pale-brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure breaking to massive; soft when dry, friable when moist; pH 8.2; violently effervescent; common, medium, distinct concretions of lime; few, faint, medium iron stains.

Variations result mainly from differences in degree of erosion. The texture of the surface layer is predominantly silt loam in areas of native grassland, but it is silty clay loam in cultivated areas. Most areas in native grass are uneroded or only slightly eroded. Sloping cultivated areas are severely eroded in places, and lime concretions are within 16 to 26 inches of the surface.

Hastings silt loam, 0 to 1 percent slopes (Hs).—This soil has moderately slow permeability and high moisture-holding capacity. As much as 20 percent of some of the areas mapped consists of Crete soils.

This soil can be used for row crops year after year if fertilized adequately and kept in good tilth. The return of crop residue supplies organic matter and helps to maintain tilth. Irrigated crops usually need nitrogen and phosphorus.

Grain sorghum, wheat, corn, and alfalfa are the principal dryland crops, and grain sorghum and corn the principal irrigated crops. (Dryland capability unit I–1; irrigated capability unit I–1; Silty range site; Silty to Clayey windbreak group)

Hastings silt loam, 1 to 3 percent slopes (HsA).—This soil is slightly to moderately eroded but is well suited to cultivation. The organic-matter content is high, and tilth is easily maintained.

Most of the acreage is cultivated. Wheat, grain sorghum, corn, and alfalfa are the principal dryland crops. Grain sorghum and corn are the principal irrigated crops. Contour farming, terraces, and grassed waterways are needed to reduce runoff and thereby control erosion and conserve moisture. (Dryland capability unit IIe–1; irrigated capability unit IIe–1; Silty range site; Silty to Clayey windbreak group)

Hastings silt loam, 3 to 7 percent slopes (HsB).—This soil occurs on sloping ridgetops and short side slopes along drainageways. Although it is suitable for cultivated crops, most of the acreage is in native grasses. Cultivated areas need to be protected against erosion by contour farming, terracing, keeping grass in waterways, and applying fertilizer. Grain sorghum, wheat, corn, and alfalfa are suitable crops. (Dryland capability unit IIIe–1; irrigated capability unit IIIe–1; Silty range site; Silty to Clayey windbreak group)

Hastings silt loam, 7 to 11 percent slopes (HsC).—The surface layer of this soil consists of 8 to 11 inches of silt loam, and the subsoil of 14 to 22 inches of silty clay loam. The depth to lime ranges from 30 to 38 inches. In other characteristics, the profile is like that described as typical of the series. Included in the areas mapped are areas of Geary soils that make up as much as 20 percent of the acreage on the lower part of side slopes.

Most of this soil is in native grasses. A vigorous stand of grasses helps in the control of erosion and the conservation of moisture, which are the main management problems. Practices needed if crops are grown include terracing, contour farming, and keeping grass in waterways. Wheat and alfalfa are the principal crops. A row crop of grain sorghum can be grown occasionally. (Dryland capability unit IVe–1; Silty range site; Silty to Clayey windbreak group)

Hastings silty clay loam, 0 to 1 percent slopes (Ht).—This soil occurs on high terraces south of the Little Blue River and west of Hebron. The surface layer puddles readily if worked when wet, and when dry it becomes hard.

This soil absorbs water moderately slowly. Runoff is medium. The addition of organic matter improves tilth and reduces the likelihood of crusting. Most of the acreage is cultivated. (Dryland capability unit I–1; irrigated capability unit I–1; Silty range site; Silty to Clayey windbreak group)

Hastings silty clay loam, 3 to 7 percent slopes, eroded (HtB2).—This soil (fig. 5) occurs mainly on sloping ridgetops and on short side slopes along drainageways. The surface layer is dark grayish-brown silty clay loam 4 to 7 inches thick. The subsoil is slightly acid, dark-brown silty clay loam 20 to 24 inches thick. It has blocky structure. In places erosion has exposed the lighter colored lower part of the subsoil. As much as 10 percent of some of the areas mapped consists of Geary soils.

This soil is fairly well suited to cultivated crops. Most of the acreage is cultivated, and some of it is irrigated. Control of erosion and conservation of moisture are the main management problems. The practices needed include terracing, contour farming, keeping grass in waterways, and applying fertilizer. Grain sorghum and wheat are the principal crops. Corn and alfalfa are also grown. (Dryland capability unit IIIe–1; irrigated capability unit IIIe–1; Silty range site; Silty to Clayey windbreak group)

Hastings silty clay loam, 7 to 11 percent slopes, eroded (HtC2).—The surface layer of this soil consists of 5 to 8 inches of silty clay loam. In most places it is dark colored, but in some it has been severely eroded and consequently is light colored. The subsoil is 14 to 22 inches of silty clay loam. The upper part of the substratum contains lime. In other characteristics, the profile is like that described as typical of the series. As much as 20 percent of some areas consists of Geary soils.

***Figure 5.*—Profile of Hastings silty clay loam, 3 to 7 percent slopes, eroded.**

This soil is moderately low in organic-matter content and in natural fertility. Control of erosion and conservation of moisture are the main management problems. Practices needed are terracing, contour farming, keeping grass in waterways, and applying fertilizer.

Wheat and alfalfa are the most suitable crops, but grain sorghum is grown occasionally. Most of the acreage is cultivated. (Dryland capability unit IVe–1; Silty range site; Silty to Clayey windbreak group)

Hastings soils, eroded (Hs2).—These soils are gently sloping to moderately sloping. They have a thin surface layer of dark-brown silty clay loam. Rills and small, crossable gullies are numerous. Included in the areas mapped are areas of Hastings silty clay loam, eroded, that make up as much as 20 percent of the acreage.

Surface runoff is rapid because the soils are compact and low in organic-matter content. Control of erosion and conservation of moisture are the main management problems. The practices needed include terracing, contour farming, establishing waterways, returning crop residue, and applying fertilizer.

Grain sorghum and alfalfa are the crops most commonly grown. Most of the acreage is cultivated. (Dryland capability unit IVe–8; Silty range site; Silty to Clayey windbreak group)

Hobbs Series

The Hobbs series consists of deep, dark-colored, medium-textured soils that developed mainly in noncalcareous, medium-textured and moderately fine textured sediments. They occur on narrow bottom lands along intermittent drainageways and on wide bottom lands and foot slopes in the valleys of perennial streams. They are well drained. The slope is as much as 4 percent. Areas along intermittent drainageways are occasionally flooded for short periods after heavy rainstorms. Areas along perennial streams and on foot slopes are seldom flooded. The profile consists of light- and dark-colored stratified material. The native vegetation was mid and tall grasses.

The surface layer consists of very dark brown, noncalcareous loam or light silty clay loam 14 to 24 inches thick. This layer is friable and has granular structure. It is neutral to slightly acid.

The subsoil is very dark grayish-brown, noncalcareous silt loam 24 to 42 inches thick. Its color lightens as depth increases. It is friable but more compact than the surface layer.

The substratum, to a depth of 5 feet or more, is dark grayish-brown or brown, noncalcareous silt loam.

These soils are friable and absorb water readily. Their natural fertility is high. Grain sorghum, corn, wheat, and alfalfa are the principal crops. Response to fertilizer is good. Most of the acreage is well suited to irrigation.

In this county, Hobbs soils are associated with Cass and Muir soils. They have a more silty and darker colored subsoil and substratum than Cass soils. Their horizonation is weaker than that of Muir soils, and they are more stratified than those soils.

Typical profile of Hobbs silt loam, seldom flooded, in a cultivated field 0.15 mile north and 100 feet west of the east quarter corner of sec. 27, T. 4 N., R. 3 W.

Ap—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; pH 6.6; abrupt, smooth boundary.

A12—5 to 26 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure breaking to weak, medium, granular; slightly hard when dry, very friable when moist; pH 6.8; clear, smooth boundary.

AC—26 to 38 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to weak, fine, subangular blocky; slightly hard when dry, very friable when moist; pH 7.0; clear, smooth boundary.

C—38 to 58 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular

blocky structure breaking to weak, medium, subangular blocky; slightly hard when dry, very friable when moist; pH 7.2.

Variations in the profile are generally uncommon, but in some places buried, darkened layers occur in the profile. The frequency of flooding is associated with elevation above the stream channel.

Hobbs silt loam, seldom flooded (Hb).—This soil is well drained. It occurs on bottom lands in the valleys of perennial streams. It is flooded only after rapid snowmelt or after extremely heavy rain.

The surface layer is dark-colored, friable silt loam 18 to 32 inches thick. The subsoil is slightly more compact than the surface layer and is moderately permeable.

This soil is well suited to irrigation. Grain sorghum, corn, wheat, and alfalfa are commonly grown. Tillage is easy. Fertilizer is needed. (Dryland capability unit I–1; irrigated capability unit I–1; Silty Lowland range site; Silty to Clayey windbreak group)

Hobbs silt loam, occasionally flooded (2Hb).—This soil formed in silty alluvium. The occasional floods follow heavy rainfall and are of short duration. The moisture-holding capacity is high, and permeability is moderate. Tilth is good.

This soil can be used year after year for cultivated crops. Flooding seldom causes a total crop loss, but at times it delays tillage or necessitates reseeding of newly planted crops. If flooding occurs late in spring or early in summer, it may be necessary to replant with crops that have a shorter growing season. Nitrogen fertilizer is needed if row crops are grown continuously. Not much of the acreage is irrigated, because of the flood hazard and the irregular distribution of the areas.

Grain sorghum, corn, and alfalfa are the most common crops. Wheat is not grown extensively, because of the flood hazard. (Dryland capability unit IIw–3; irrigated capability unit I–1; Silty Overflow range site; Moderately Wet windbreak group)

Hobbs silt loam, 1 to 4 percent slopes (HbA).—This soil is high in natural fertility and in organic-matter content. It absorbs water readily and has a high moisture-holding capacity.

Most of the acreage is cultivated. Some of it is irrigated. Grain sorghum, corn, wheat, and alfalfa are the principal crops. Terraces or diversions are needed on the adjacent slopes to control washing and flooding. (Dryland capability unit IIe–1; irrigated capability unit IIe–1; Silty Lowland range site; Silty to Clayey windbreak group)

Jansen Series

The Jansen series consists of moderately deep, loamy soils (fig. 6) that developed mainly in loess overlying sand and gravel. These soils are gently sloping to strongly sloping. They occur on uplands in the central and east-central parts of the county, generally on upland breaks along the Little Blue River and Big Sandy Creek.

The surface layer consists of loam or clay loam. In uneroded areas, it is 7 to 13 inches thick. It is generally dark grayish brown when dry. Gravelly material occurs on the surface in some places. In its natural state, this layer is granular and friable and neutral to slightly acid. Grass roots are abundant.

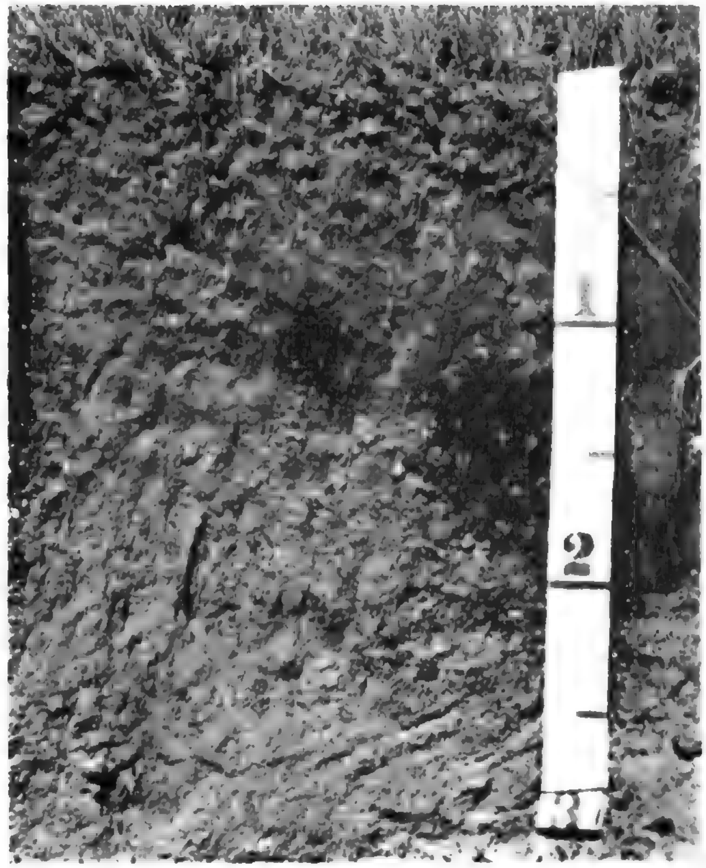

Figure 6.—**Profile of Jansen loam.**

The subsoil consists of reddish-brown loam and is 8 to 30 inches thick. It is slightly hard when dry and friable when moist. It has a blocky structure. The reaction is neutral. Grass roots are fewer than in the surface layer.

The underlying material consists of stratified sand, coarse sand, and gravel. In the uppermost 6 to 10 inches of the substratum, some fine material is mixed with the coarse material. The depth to the substratum is generally about 28 inches but ranges from 15 to 38 inches.

These soils are droughty and erodible. Surface runoff is moderate, and permeability is moderately rapid to rapid. Natural fertility is moderate to low. Only about half of the acreage is used for cultivated crops. The rest is used for native pasture. Because of the slope, irrigation is not practical.

In this county, Jansen soils are associated with Geary and Meadin soils. Their parent loess was thinner than that of the Geary soils. They are deeper over sand and gravel than the Meadin soils.

Typical profile of Jansen loam, 7 to 11 percent slopes, in a pasture 0.4 mile west and 50 feet north of the southeast corner of sec. 31, T. 4 N., R. 2 W.

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; dark reddish brown (5YR 3/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular; slightly hard when dry, friable when moist; pH 6.6; noncalcareous; clear, smooth boundary.

B2—8 to 17 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; weak, coarse, subangular blocky structure breaking to weak,

medium, subangular blocky; slightly hard when dry, friable when moist; pH 6.8; noncalcareous; clear, smooth boundary.

C1—17 to 26 inches, reddish-gray (5YR 5/2) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 6.8; noncalcareous; gradual, wavy boundary.

C2—26 to 42 inches +, light reddish-brown (5YR 6/3) sand and gravel, yellowish red (5YR 5/6) when moist; single grain; loose when dry or moist; pH 6.8; noncalcareous.

Some coarse sand and gravel is scattered throughout the profile. The depth to the coarse-textured substratum varies. These soils are more nearly reddish brown in color and finer in texture with increase of depth to the parent loess.

Jansen loam, 7 to 11 percent slopes (JaC).—On the average this soil is 28 inches deep to coarse material, mostly coarse sand and gravel. Some areas are moderately eroded, and in these the surface layer is 5 to 9 inches thick.

This soil is more droughty than similar soils underlain by moderately coarse textured material. Surface runoff ranges from moderate to rapid, depending on the amount of vegetation. A vigorous stand of grasses is needed to help conserve moisture.

This soil is suitable for dryland cultivation if managed so as to conserve moisture, control erosion, and maintain fertility. Small grain is the main crop, and grain sorghum is grown occasionally. Most of the acreage is in native grasses and is used for pasture. (Dryland capability unit IVe–1; Silty range site; Silty to Clayey windbreak group)

Jansen sandy clay loam, 7 to 11 percent slopes, eroded (JsC2).—This soil is on upland side slopes and ridgetops. It is 14 to 28 inches deep to sand and gravel. Its surface layer is lighter colored than that of uneroded Jansen soils. There are many rills and small gullies.

This soil is shallow and droughty and is susceptible to further erosion. It is low in fertility and in organic-matter content. Tilth can be improved and fertility can be increased by returning crop residue to the soil and by applying fertilizer. Terraces and waterways help to conserve moisture and control water erosion.

Although this soil is better suited to native grasses than to crops, most of the acreage has been cultivated. (Dryland capability unit IVe–8; Silty range site; Silty to Clayey windbreak group)

Jansen-Meadin complex, 5 to 11 percent slopes (JMC).—This complex occurs on side slopes in the valleys of the Little Blue River and Big Sandy Creek, and in the valleys of their tributaries. About 60 to 75 percent of the complex consists of Jansen soils, 20 to 35 percent of Meadin soils, and the rest of soils similar to those of the Geary series.

The Jansen soils occur at the higher elevations; the Meadin soils are downslope from them.

The soils of this complex are moderate to low both in moisture-holding capacity and in natural fertility. The deeper soils have the higher moisture-holding capacity and the higher fertility. Surface runoff is moderate to rapid, depending on the amount of vegetation.

If these soils are cultivated, high-level management is needed to conserve moisture, to control water erosion, and to maintain fertility. Most of the acreage is in permanent pasture. (Both soils in dryland capability unit IVe–1; Jansen soils are in Silty range site, and Meadin soils are in Shallow to Gravel range site; Jansen soils are in Silty to Clayey windbreak group, and Meadin soils are in Shallow windbreak group)

Jansen-Meadin complex, 5 to 11 percent slopes, eroded (JMC2).—The soils of this complex occur in nearly equal proportions. Erosion has removed nearly all of the surface layer and part of the subsoil.

These soils are low in natural fertility and in organic-matter content.

Most of the acreage has been cultivated. Wheat and grain sorghum are the crops most commonly grown. Terraces, grassed waterways, and contour farming help to control water erosion and to conserve moisture. Fertilization and the return of crop residue are needed to increase fertility and to improve tilth. These soils could be seeded to native grasses. (Both soils in dryland capability unit IVe–8; Jansen soils are in Silty range site, and Meadin soils are in Shallow to Gravel range site; Jansen soils are in Silty to Clayey windbreak group, and Meadin soils are in Shallow windbreak group)

Jansen-Meadin complex, 11 to 30 percent slopes (JMD).—This complex occurs on the side slopes of intermittent drainageways leading into the valleys of the Little Blue River and Big Sandy Creek. About 40 to 60 percent of it consists of Jansen soils, 35 to 55 percent of Meadin soils, and the rest of Geary soils.

These soils are not suitable for cultivation. Most of the acreage is in native grasses and is used for pasture. The Meadin soils are droughty, and their vegetative cover is sparse. The Jansen soils support a fair to good cover of mid and tall native grasses. A vigorous stand of grasses would help to control water erosion and to conserve moisture. (Both soils in dryland capability unit VIe–1; Jansen soils are in Silty range site, and Meadin soils are in Shallow to Gravel range site; both soils in Silty to Clayey windbreak group)

Jansen-Meadin complex, 11 to 30 percent slopes, eroded (JMD2).—The soils of this complex are similar to the uneroded soils of the Jansen-Meadin complex, 11 to 30 percent slopes. The Meadin soils make up the larger part. Erosion has removed all of the surface layer and part of the subsoil.

These soils are low in natural fertility. Their organic-matter content is low. Surface runoff is rapid.

These soils are not suitable for cultivation. They ought to be seeded to native grasses. A vigorous stand of grasses would help to control water erosion and to conserve moisture. (Both soils in dryland capability unit VIe–8; Jansen soils are in Silty range site, and Meadin soils are in Shallow to Gravel range site; both soils in Silty to Clayey windbreak group)

Kipp Series

The Kipp series consists of moderately deep, dark-colored, clayey soils that developed over interbedded limestone and limy shale. These soils are strongly sloping. They occur on uplands in the southeastern and east-central parts of the county. In most places the uppermost part of the profile contains an accumulation of loess. In this county Kipp soils are mapped only with Wakeen soils, as part of an undifferentiated unit.

The surface layer consists of very dark grayish-brown, calcareous silty clay loam 8 to 12 inches thick. It has

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granular structure and is friable when moist. As it dries, it hardens and develops small shrinkage cracks.

The subsoil consists of dark reddish-brown (5YR 3/4) silty clay loam or silty clay 8 to 20 inches thick. The lower part of this horizon contains many medium and large concretions of lime.

The substratum consists of interbedded limestone and limy shale. The depth to the substratum generally is between 20 and 36 inches but ranges to 48 inches.

These soils absorb water slowly. Natural fertility is moderate. Most of the acreage is cultivated; less than 20 percent is in native grasses. All of the common crops are grown.

In this county Kipp soils are associated with Wakeen soils. Their subsoil is more clayey than that of Wakeen soils and has a pronounced reddish tinge, which is lacking in Wakeen soils.

Typical profile of Kipp silty clay loam, 7 to 11 percent slopes, in a cultivated field 0.4 mile north and 0.1 mile east of the south quarter corner of sec. 23, T. 1 N., R. 1 W.

A1—0 to 8 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist; pH 8.2; slightly effervescent; few fine lime concretions; clear, smooth boundary.

B21t—8 to 11 inches, reddish-brown (5YR 5/4) silty clay, dark reddish brown (5YR 3/4) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; pH 8.4; violently effervescent; numerous medium and large lime concretions; clear, smooth boundary.

B22t—11 to 20 inches, reddish-brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/4) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; very hard when dry, firm when moist; pH 8.6; violently effervescent; numerous medium and large lime concretions; clear, smooth boundary.

R—20 to 30 inches +, interbedded limestone and limy shale.

The depth to interbedded limestone and limy shale varies greatly within short distances.

Kipson Series

The Kipson series consists of shallow, medium-textured soils (fig. 7) that developed in material weathered from interbedded limestone and limy shale. A thin mantle of loess overlies the limestone in some places. These soils occur in the southeastern corner of the county south of Rose Creek and on valley side slopes in the east-central part of the county on both sides of the Little Blue River. The native vegetation consisted mainly of grasses. Scattered oaks grew on the steeper banks of drainageways.

The surface layer consists of very dark grayish-brown, calcareous heavy silt loam 5 to 13 inches thick. In its natural state, this layer has granular structure and is friable when moist. Roots are abundant. Small fragments of limestone occur in this layer.

The subsoil consists of 7 to 12 inches of partly weathered, soft limestone or limy shale. Small and medium fragments of limestone are numerous. There are some grass roots, but they decrease rapidly with depth.

The underlying bedrock is medium-soft, gray to very pale brown, interbedded limestone and limy shale. Some soil material and material weathered from the bedrock is intermixed with the uppermost part of the substratum.

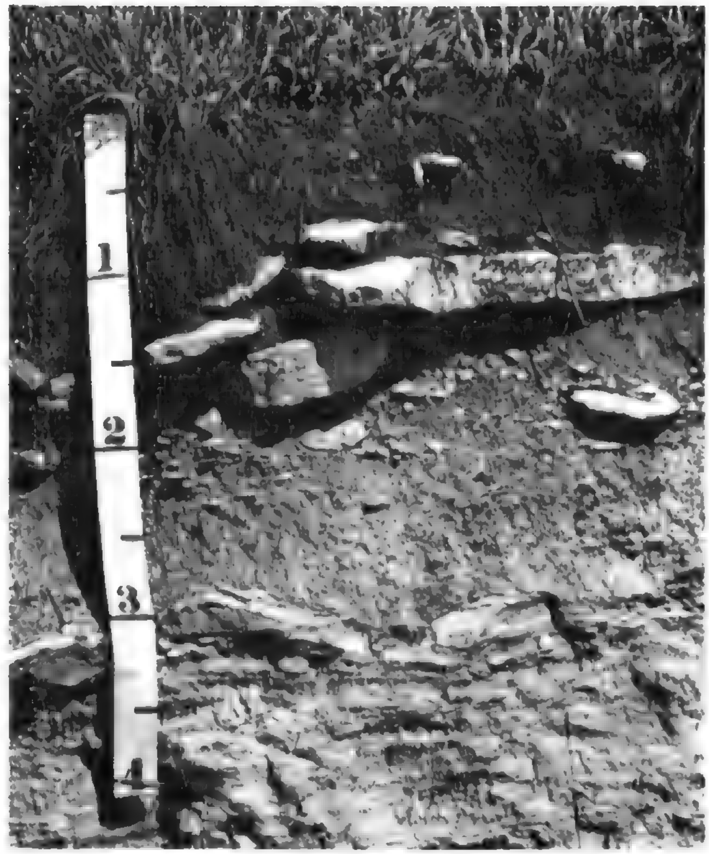

Figure 7.—Profile of Kipson silt loam.

This material is sufficiently fragmented to permit root penetration.

Kipson soils are too steep and too shallow for successful cultivation. Nearly all of the acreage is in permanent pasture.

In this county Kipson soils are associated with Wakeen soils. They are steeper and shallower than those soils, and their horizonation is less distinct.

Typical profile of Kipson soils, 11 to 30 percent slopes, in a pasture of native grasses 100 feet north and 50 feet east of the west quarter corner of sec. 32, T. 1 N., R. 1 W.

A11—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; soft when dry, friable when moist; pH 8.4; violently effervescent; gradual, smooth boundary.

A12—7 to 13 inches, gray (10YR 5/1) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; hard when dry, firm when moist; pH 8.4; violently effervescent; numerous small limestone fragments; gradual, wavy boundary.

AC—13 to 21 inches, brown (10YR 5/3) weathered limestone and small fragments, brown (10YR 5/3) to very pale brown (10YR 7/4) when moist; moderate, thick and medium, platy structure; hard when dry, firm when moist; pH 8.4; violently effervescent; gradual, wavy boundary.

R—21 to 36 inches +, light-gray (10YR 7/2), slightly weathered and fractured limestone; large rocks; very pale brown (10YR 7/4) when moist; massive; very hard when dry; pH 8.6; violently effervescent.

Minor variations in the thickness of the surface layer and in the depth to the substratum occur within short distances. The size and number of limestone fragments in the surface layer vary. Limestone fragments wash downslope from higher lying soils. In places unweathered limestone and limy shale are exposed.

Kipson soils, 11 to 30 percent slopes (KpD).—These soils occupy positions ranging from steep, irregular valley side slopes along the Little Blue River to the more uniform, strongly sloping areas southeast of Rose Creek. Included in the areas mapped are areas of very shallow soils that developed over limestone. These inclusions make up as much as 30 percent of the acreage in places.

Surface runoff is rapid. These soils absorb water readily, but because they are shallow they have a low moisture-holding capacity. Natural fertility is moderate.

Most areas of these soils are in native grasses, mainly big bluestem, little bluestem, indiangrass, and switchgrass. Maintaining a vigorous stand of grasses is the main management problem. Grass is needed to control runoff and conserve moisture. (Dryland capability unit VIs–4; Shallow Limy range site; Shallow windbreak group)

Lamo Series

The Lamo series consists of deep, somewhat poorly drained soils that developed in moderately fine textured, calcareous, clayey alluvium. The depth to the water table fluctuates between 2 feet and 6 feet and averages 38 inches. These soils occur on nearly level bottom lands and, in some places, on low benches near upland deposits of loess. Some of the areas along intermittent drainageways are flooded occasionally.

The surface layer consists of black to very dark grayish-brown, calcareous silty clay loam 10 to 20 inches thick. It is very hard when dry.

The subsoil is very dark grayish-brown, calcareous silty clay loam 8 to 16 inches thick. It has subangular blocky structure. It is more compact than the surface layer and is very hard when dry. The lower part of the subsoil is mottled.

The underlying material is mainly calcareous, medium-textured to moderately fine textured alluvium. In some places it is more sandy and contains stratified silty and clayey material.

Surface runoff is slow, and permeability is slow. The moisture-holding capacity is high.

Grain sorghum, corn, and alfalfa are suitable crops. Wheat is not well suited, because the water table is high in spring. The high water table is beneficial, however, to other dryland crops. These soils puddle readily if they are worked or trampled when wet.

In this county Lamo soils on low terraces are associated with Muir and Detroit soils, and those on bottom lands are associated with Cass soils. Lamo soils have a more clayey subsoil than Muir and Cass soils. They are more poorly drained than Detroit and Muir soils.

Typical profile of Lamo silty clay loam, in a pasture 100 feet west and 100 feet north of the south quarter corner of sec. 8, T. 2 N., R. 2 W.

A11—0 to 12 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; hard when dry, friable when moist; pH 8.0; slightly effervescent; clear, smooth boundary.

A12—12 to 19 inches, gray (10YR 5/1) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, fine and medium, subangular blocky; very hard when dry, friable when moist; pH 8.0; slightly effervescent; clear, smooth boundary.

AC—19 to 29 inches, gray (2.5Y 5/0) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, fine, subangular blocky; very hard when dry, friable when moist; pH 8.2; strongly effervescent; clear, smooth boundary.

C1—29 to 36 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; very hard when dry, friable when moist; pH 8.2; violently effervescent; gradual, smooth boundary.

C2—36 to 52 inches, light-gray (2.5Y 7/2) light silty clay loam, grayish brown (2.5Y 5/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, fine and medium, subangular blocky; hard when dry, friable when moist; pH 8.2; violently effervescent.

The water table is highest early in spring and lowest late in summer. Some small areas of these soils have an accumulation of excess sodium or other salts.

Lamo silty clay loam (Lb).—This soil occurs mainly on the nearly level bottom lands along the Little Blue River. In some years the water table is high enough to cause excessive wetness, but it also often supplies moisture to crops. Corn, grain sorghum, and alfalfa are the main crops.

Some areas are used for pasture, but most of the acreage is cultivated. Little of this soil is irrigated. (Dryland capability unit IIw–4; irrigated capability unit IIw–4; Subirrigated range site; Moderately Wet windbreak group)

Lamo silty clay loam, drained (2Ly).—This soil is on bottom lands south of Rose Creek. It has the characteristics of somewhat poorly drained soils. It is calcareous throughout and is mottled in the lower part. The depth to the present water table is seldom less than 60 inches.

Most of the acreage is cultivated. Corn, grain sorghum, wheat, and alfalfa are the principal crops. The water table is not high enough to cause excessive wetness or to delay tillage, and it provides subirrigation that benefits crops. Not much of the acreage is irrigated, because the water supply is limited. Fertilizer is needed, and crop residue should be returned. (Dryland capability unit I–1; irrigated capability unit I–1; Clayey range site; Silty to Clayey windbreak group)

Lancaster Series

The Lancaster series consists of deep and moderately deep, medium-textured to moderately coarse textured, somewhat excessively drained soils that developed in material weathered from sandstone. These soils are moderately sloping to strongly sloping. They occur on uplands along the eastern boundary of the county, south of Rose Creek. They range from 18 to 36 inches in depth. The native vegetation consisted mainly of mid and tall prairie grasses.

In uneroded areas the surface layer is dark-brown, medium acid loam or fine sandy loam 6 to 14 inches thick. Most of the acreage is eroded, however, and consequently the surface layer is thinner and has a dark reddish-brown color.

The subsoil is predominantly loam but ranges from clay loam to sandy clay. It is 8 to 20 inches thick and is dark

brown to dark reddish brown. It has weak, blocky structure and is slightly acid.

The substratum consists mainly of broken and slightly weathered, yellowish-red or reddish-brown sandstone, mixed with shale in the lower part.

These soils are slightly acid to medium acid. Permeability is moderately rapid.

Grain sorghum, corn, and wheat are the most common cultivated crops. The most common native grasses are big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama.

In this county, Lancaster soils are associated with Wakeen and Kipson soils. They contain less clay than Wakeen and Kipson soils, and they formed in weathered sandstone, rather than in weathered limestone.

Typical profile of Lancaster loam, 7 to 16 percent slopes, severely eroded, in a cultivated field 0.25 mile south and 50 feet west of the northeast corner of sec. 13, T. 1 N., R. 1 W.

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, dark reddish brown (5YR 3/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular; soft when dry, very friable when moist; pH 6.6; noncalcareous; abrupt, smooth boundary.

B2—5 to 11 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, subangular blocky; slightly hard when dry, friable when moist; pH 6.6; noncalcareous; clear, smooth boundary.

B3—11 to 17 inches, strong-brown (7.5YR 5/6) very fine sandy loam, dark brown (7.5YR 4/4) when moist; weak, coarse, subangular blocky structure breaking to weak, medium and fine, subangular blocky; slightly hard when dry, friable when moist; pH 6.4; noncalcareous; clear, smooth boundary.

C—17 to 26 inches, reddish-yellow (7.5YR 6/6) very fine sandy loam, strong brown (7.5YR 5/6) when moist; weak, coarse, subangular blocky structure breaking to weak, medium, subangular blocky; hard when dry, friable when moist; pH 6.8; noncalcareous; gradual, wavy boundary.

R—26 to 42 inches +, yellowish-red (5YR 5/8) sandstone (variegated sandstone and some lenses of shalelike material); reddish-brown (5YR 4/4) when moist; massive; very hard when dry, very firm when moist; noncalcareous.

Fragments of sandstone are scattered throughout the profile.

Lancaster loam, 7 to 16 percent slopes, severely eroded (LcD3).—This soil is on valley side slopes. Erosion has removed most of the original surface layer. The present surface layer is dark reddish brown, is more sandy than the original, and contains many small fragments of sandstone. The depth to weathered sandstone is ordinarily about 26 inches, but in places it is as much as 42 inches. There are a few rills and crossable gullies on the hillsides. As much as 20 percent of some of the areas mapped consists of shallow or moderately deep soils that developed over limestone.

This soil is low in organic-matter content and in fertility. Management practices needed include returning crop residue to maintain organic-matter content, terracing to control erosion and conserve moisture, and fertilizing to increase yields.

This soil is used for grain sorghum and corn. It is not well suited to alfalfa unless lime is applied. Some of the acreage is used for wheat. Most of the acreage is cultivated. (Dryland capability unit IVe-8; Silty range site; Silty to Clayey windbreak group)

Meadin Series

The Meadin series consists of shallow, moderately dark-colored soils (fig. 8) that developed in loamy deposits overlying coarse sand and gravel. These soils are on gently rolling ridges and steep side slopes. They occur on uplands in the central part of the county, along intermittent drainageways leading into the Little Blue River and Big Sandy Creek. The native vegetation is sparse.

Figure 8.—**Profile of Meadin loam.**

The surface layer consists of very dark grayish-brown loam to sandy loam 4 to 11 inches thick. It is medium acid. In most places gravel is scattered throughout this layer.

Between the surface layer and the underlying sand and gravel is a transitional layer, 5 to 9 inches thick, of dark-brown to dark grayish-brown loam to sandy loam mixed with gravel. This layer is slightly acid.

The underlying coarse sand and gravel is somewhat stratified as a result of sorting during deposition.

These soils are excessively drained. Natural fertility is low. Droughtiness, erodibility, and the slope make these soils unsuitable for cultivation. Most of the acreage is in native grasses.

In this county Meadin soils are associated with Jansen and Geary soils. They are shallower than Jansen soils.

They are shallower and less clayey than Geary soils and occur at lower elevations than those soils.

Typical profile of Meadin loam, 3 to 30 percent slopes, in a pasture of native grasses 0.3 mile east and 0.2 mile north of the southwest corner of sec. 10, T. 2 N., R. 2 W.

A1—0 to 11 inches, gray (10YR 5/1) loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular; soft when dry, friable when moist; pH 6.5; clear, smooth boundary.

AC—11 to 15 inches, brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular; soft when dry, friable when moist; pH 6.5; gradual, wavy boundary.

IIC—15 to 42 inches +, pale-brown (10YR 6/3) sand and gravel, yellowish brown (10YR 5/6) when moist; single grain; loose when dry, loose when moist; pH 6.2.

Variations in the profile occur within short distances. The depth to coarse sand and gravel ranges from just a few inches to as much as 30 inches, depending on topography, the degree of erosion, and the pattern of deposition of the parent material.

Meadin loam, 3 to 30 percent slopes (Mw).—This soil is 12 to 26 inches thick over a substratum of coarse sand and gravel. As much as 20 percent of some of the areas mapped consists of Jansen soils.

This soil is not suitable for cultivation but is suited to permanent pasture. The management practices most needed are protection from overgrazing and conservation of moisture. Proper grazing use helps to maintain a vigorous stand of grasses, and the grasses help to reduce runoff and conserve moisture. The main pasture plants are blue grama, sideoats grama, sand dropseed, annual grasses, and weeds. Areas that have been cultivated are severely eroded and should be seeded to native grasses. (Dryland capability unit VIs-4; Shallow to Gravel range site; Shallow windbreak group)

Muir Series

The Muir series consists of deep, dark-colored, medium-textured soils that developed in silty alluvium. These soils occur on benches, terraces, and side slopes along streams. They are nearly level to gently sloping. The native vegetation was mainly grasses and a few scattered trees.

The surface layer consists of black to very dark grayish-brown silt loam 14 to 24 inches thick. It is neutral to slightly acid. In its natural state, this layer has granular structure and is very friable when moist.

The subsoil consists of very dark grayish-brown, slightly compact silt loam 12 to 22 inches thick. It is neutral in reaction. It has weak, subangular blocky structure. The color becomes slightly lighter with depth.

The underlying material is dark-brown, silty to slightly sandy alluvium to a depth of 5 feet or more. In some places the alluvium is stratified. Free lime generally does not occur in the uppermost 4 feet of the profile.

These soils absorb water readily and have a moderately high moisture-holding capacity. They are easy to work.

Grain sorghum, corn, wheat, and alfalfa are the principal dryland crops. Corn and grain sorghum are the principal irrigated crops. Most of the acreage is cultivated.

In this county Muir soils are associated with Detroit and Hobbs soils. Their subsoil is less clayey and more friable than that of Detroit soils. Their horizonation is stronger than that of Hobbs soils, and they are less stratified than those soils.

Typical profile of Muir silt loam in a cultivated field, 0.1 mile south and 50 feet west of the northeast corner of sec. 26, T. 3 N., R. 4 W.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; pH 6.8; abrupt, smooth boundary.

A1—6 to 16 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure breaking to moderate, fine, granular; soft when dry, very friable when moist; pH 7.0; clear, smooth boundary.

B2—16 to 30 inches, dark-gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium and fine, subangular blocky; slightly hard when dry, friable when moist; pH 7.0; clear, smooth boundary.

B3—30 to 36 inches, brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; pH 7.0; clear, smooth boundary.

C—36 to 65 inches +, light brownish-gray (10YR 6/2) silt loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; pH 7.0.

Variations in the profile are uncommon. Buried soils occur in some places. The profile is more sandy in some areas along the breaks between benches and bottom lands.

Muir silt loam, 0 to 1 percent slopes (Mu).—This soil is suited to all of the crops grown in the county. It is well suited to irrigation. If fertility is maintained and if crop residue is returned to the soil, row crops can be grown year after year. Corn and grain sorghum are the principal irrigated crops. (Dryland capability unit I-1; irrigated capability unit I-1; Silty Lowland range site; Silty to Clayey windbreak group)

Muir silt loam, 1 to 3 percent slopes (MuA).—This soil occurs on side slopes along shallow, intermittent drainageways on terraces and on the side slopes of ridges near the loessal uplands. In some places the surface layer has been thickened by local colluvium and alluvium.

If fertilizer is applied and if the moisture supply is adequate, all the common crops can be grown. All crop residue should be returned to the soil. (Dryland capability unit IIe-1; irrigated capability unit IIe-1; Silty Lowland range site; Silty to Clayey windbreak group)

Muir silt loam, 3 to 7 percent slopes, eroded (MuB2).—This soil occurs on side slopes along intermittent drainageways. Both the surface layer and the subsoil are thinner than those in the profile described as typical of the series. The surface soil ranges from 6 to 14 inches in thickness. It is mostly dark colored but has a few lighter colored spots in severely eroded areas. The subsoil is very dark grayish-brown silt loam 8 to 12 inches thick.

Terraces are needed to help conserve moisture and control erosion. Crop residue should be returned and fertilizer applied. Most of the acreage is cultivated. (Dryland capability unit IIIe-1; irrigated capability unit IIIe-1; Silty Lowland range site; Silty to Clayey windbreak group)

Muir-Meadin complex, 0 to 3 percent slopes (MQ).—This complex occurs in the eastern part of the county, on colluvial foot slopes and near drainage outlets that lead onto terraces in the valleys of the Little Blue River and

Big Sandy Creek. About 60 to 70 percent of this complex consists of Meadin soils, and the rest of Muir soils.

The Meadin soils are moderately deep to shallow, and the Muir soils are deep. In many places the underlying sandy and gravelly material crops out, and in cultivated areas this material has been spread and mixed with the cultivated soil.

These soils are associated with more productive soils, and consequently most of the acreage is cultivated. Irrigating is difficult because of the variations in depth and the irregular topography.

Wheat, grain sorghum, and corn are the principal crops. Blue grama, sideoats grama, big bluestem, and little bluestem are suitable pasture plants. (Both soils in dryland capability unit IIIe–3 and in irrigated capability unit IIe–3; Muir soils are in Silty Lowland range site; Meadin soils are in Shallow to Gravel range site; both soils in Silty to Clayey windbreak group)

Sandy Alluvial Land

Sandy alluvial land (Sx) occurs on flood plains adjacent to the Little Blue River and in old channels of the river. The areas are irregular in size and are marked with low mounds and channels formed by floodwaters. The areas on flood plains are 1 to 3 feet above normal streamflow. The soil material is mainly sandy loam to loamy sand, and most of it is low in organic-matter content.

Annual weeds, brush, and willows grow on the flood plains. Because of scouring and cutting by floodwaters, the plant cover is unstable. In the old channels, where the soil material is more stable, there are dense stands of willows, cottonwoods, annual weeds, and common reedgrass.

These areas are used for pasture. The more thickly vegetated parts provide wildlife habitats. (Dryland capability unit VIIs–3; Sandy Lowland range site; Nonplantable windbreak group)

Scott Series

The Scott series consists of deep, dark-colored, very poorly drained soils that have a claypan. These soils developed in loess. They occur in depressions on the uplands. They receive runoff from surrounding sloping areas.

The surface layer is very dark gray to very dark brown, friable silt loam 4 to 8 inches thick. It has granular structure and is slightly acid to medium acid. A dark-gray to gray, leached layer, 1 to 3 inches thick, is just below the surface layer.

The subsoil is very dark brown or black clay 24 to 52 inches thick. It has strong prismatic to blocky structure. It is sticky and plastic when wet and very hard when dry. It is slightly acid to neutral. Mottles of olive gray are common in the lower part. Iron concretions one-fourth of an inch or less in diameter are common.

The substratum is pale-brown to pale-olive silt loam. Free lime is commonly leached to a depth of more than 54 inches.

Scott soils are slowly permeable and are frequently ponded. Water disappears slowly, by seepage or evaporation. In wet years the areas are covered with water most of the time. In dry years they produce a sparse growth of annual weeds and low-quality grasses. Some areas are nearly bare.

Unless drained, Scott soils are not well suited to cultivation. They are droughty in dry weather. Natural fertility is moderate to low. Some areas are cultivated, but most are used for pasture.

In this county, Scott soils are associated with Fillmore and Butler soils. They have a thinner surface layer and are more frequently ponded than the associated soils, and they occur at lower elevations.

Typical profile of Scott silt loam in a pasture, 0.25 mile north and 100 feet west of the southeast corner of sec. 2, T. 4 N., R. 3 W.

A1—0 to 4 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; soft when dry, friable when moist; noncalcareous; pH 6.4; abrupt, smooth boundary.

A2—4 to 6 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, subangular blocky; soft when dry, friable when moist; noncalcareous; pH 6.8; abrupt, smooth boundary.

B21t—6 to 17 inches, gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) when moist; strong, coarse, prismatic structure breaking to strong, medium, blocky; very hard when dry, very firm when moist; noncalcareous; iron stains with numerous shotlike iron concretions; pH 6.8; clear, smooth boundary.

B22t—17 to 30 inches, gray (5Y 5/1) clay, dark olive gray (5Y 3/2) when moist; strong, coarse, prismatic structure breaking to strong, medium, blocky; very hard when dry, very firm when moist; noncalcareous; iron stains with numerous shotlike iron concretions; pH 6.8; clear, smooth boundary.

B3—30 to 48 inches, light olive-gray (5Y 6/2) silty clay, olive gray (5Y 4/2) when moist; moderate, coarse, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry, firm when moist; pH 7.0; noncalcareous; gradual, smooth boundary.

C1—48 to 60 inches +, pale-yellow (5Y 7/4) silt loam, olive (5Y 5/4) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; pH 7.2; noncalcareous.

Scott soils (Sc).—These soils occur in large basins in the northern part of the county. Some areas are ponded for periods of a few days to several weeks in wet seasons.

Most of the acreage is in pasture. Some is cultivated, but yields are poor, and sometimes the entire crop drowns out. Grain sorghum is the most commonly grown crop. If graded and drained, these soils can be irrigated. Grain sorghum and corn are the principal irrigated crops. (Dryland capability unit IVw–2; Clayey Overflow range site; Nonplantable windbreak group)

Silty Alluvial Land

Silty alluvial land (Sy) occurs along narrow, intermittent streams. Most areas are in meander channels and are bordered by steep slopes. The soil material consists of dark-colored, stratified silty and sandy sediments washed from surrounding uplands. The areas are frequently flooded after heavy rainfall.

The vegetation in the more stable areas consists of many trees adjacent to the channel and a fair cover of grasses in level areas and on short slopes.

This land type is not suitable for cultivation, because the slopes are too steep and the areas too small and too irregularly shaped. Most of the acreage is in pasture. (Dryland

capability unit VIw-1; Silty Overflow range site and Silty range site; Moderately Wet windbreak group)

Wakeen Series

The Wakeen series consists of moderately deep, moderately fine textured soils (fig. 9) that developed partly in material weathered from limestone and partly in thin deposits of loess. These soils occur in the eastern part of the county, mainly above steep breaks leading into the Little Blue River and on uplands south of Rose Creek. They are moderately sloping to strongly sloping. The native vegetation was mainly grass and scattered oaks.

Figure 9.—**Profile of Wakeen silty clay loam.**

The surface layer consists of very dark grayish-brown silty clay loam 7 to 11 inches thick. Normally, this layer is noncalcareous. It has granular structure and is friable when moist. Scattered fragments of limestone occur near the surface.

The subsoil consists of silty clay loam 10 to 16 inches thick. It is dark brown in the upper part and grades to yellowish brown in the lower part. It has subangular blocky structure and is more compact than the surface layer. There are many nodules of lime and angular fragments of limestone in the lower part. Grass roots are plentiful in the upper part but decrease sharply with depth.

The underlying bedrock is medium-soft, gray limestone interbedded with gray shale.

These soils are well drained. Internal drainage is medium, and permeability is moderately slow. Natural fertility is moderate to high. Most of the acreage is used for grazing. Some of the moderately sloping areas are cultivated. Grain sorghum and wheat are the main crops. The soils puddle if worked or trampled when wet.

In this county, Wakeen soils occur with Kipp and Kipson soils. They are deeper over bedrock than Kipson soils, and their horizonation is more distinct.

Typical profile of Wakeen silty clay loam, 7 to 11 percent slopes, in a pasture of native grasses 0.15 mile west and 50 feet north of the southeast corner of sec. 26, T. 3 N., R. 1 W.

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, friable when moist; pH 8.0; strongly effervescent; clear, smooth boundary.

B2—7 to 16 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; slightly hard when dry, friable when moist; pH 8.2; violently effervescent; clear, smooth boundary.

B3—16 to 22 inches, grayish-brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) when moist; moderate, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; pH 8.4; violently effervescent; clear, smooth boundary.

C—22 to 26 inches, brown (10YR 5/3) silty clay loam, yellowish brown (10YR 5/6) when moist; weak, medium, subangular blocky structure breaking to weak, fine, subangular blocky; many, fine, prominent chips of weathered limestone, very pale brown (10YR 7/4) when moist; slightly hard when dry, friable when moist; pH 8.8; violently effervescent; abrupt, wavy boundary.

R—26 to 32 inches +, white (10YR 8/3) limestone, very pale brown (10YR 7/3) to yellow (10YR 7/6) when moist; large pieces of limestone 6 inches to 3 feet across interbedded with weathered limestone; very hard when dry, extremely firm when moist; pH 8.8; violently effervescent.

The depth to bedrock ranges from 24 to 34 inches. In cultivated areas the surface layer ranges from 0 to 5 inches in thickness, depending on the degree of erosion. The surface layer is silt loam in places, and in some areas the subsoil is silty clay. In some places the soils developed almost entirely in material weathered from limestone.

Wakeen silty clay loam, 11 to 30 percent slopes (WeD).—This soil occurs on the more uniform slopes along the southern side of Rose Creek and along its southern tributaries. As much as 25 percent of some of the areas mapped consists of soils that are shallow over limestone. The depth to bedrock ranges from 16 to 28 inches.

Surface runoff is moderate to rapid, depending on the amount of vegetative cover. Natural fertility is moderate, and the organic-matter content of the surface layer is high. Conservation of moisture and control of erosion are the main problems. Maintaining a vigorous stand of grasses increases infiltration of moisture and reduces washing.

This soil is not suited to cultivation, because of the strong slopes. Most of the acreage is in native grasses. Several small areas that were formerly cultivated have been seeded to grass. (Capability unit VIe-1; Silty range site; Silty to Clayey windbreak group)

Wakeen and Kipp silty clay loams, 7 to 11 percent slopes (WKC).—This undifferentiated unit occurs on ridges and short side slopes above the steeper breaks along intermittent drainageways. About 65 to 70 percent of it consists of Wakeen soils, and the rest of Kipp soils. Some of the areas mapped include small areas of shallow Kipson soils.

The surface layer contains an abundance of organic matter. Natural fertility is high. Most of the acreage is in native grasses and is used for hay or pasture. A vigorous stand of grasses should be maintained in order to reduce runoff and conserve moisture. (Both soils in dryland capability unit IVe-1; Wakeen soil is in Silty range site, and Kipp soil is in Clayey range site; both soils in Silty to Clayey windbreak group)

Wakeen and Kipp silty clay loams, 7 to 11 percent slopes, severely eroded (WKC3).—This undifferentiated unit occurs on short side slopes above shallow, steep soils over limestone. About 60 to 65 percent of the unit consists of Wakeen soils, and the rest of Kipp soils. Cultivated areas have a patchy appearance because of variation in the degree of erosion from one place to another. In some places light yellowish-brown material from the subsoil has been mixed with the darker colored material of the surface layer. The surface layer is strongly calcareous.

These soils are moderately low in fertility and organic-matter content. Surface runoff is moderately rapid and carries off much of the moisture. Control of erosion, conservation of moisture, and maintenance of fertility are the main problems. The practices needed are terracing, contour farming, keeping grass in waterways, returning crop residue, and applying fertilizer.

Wheat and alfalfa are the most suitable crops, but grain sorghum can be grown occasionally. These soils are also suitable for pasture and can be seeded to native grasses. Most of the acreage is cultivated. (Both soils in dryland capability unit IVe–8; Wakeen soil is in Silty range site, and Kipp soil is in Clayey range site; both soils in Silty to Clayey windbreak group)

Use and Management of the Soils

The first part of this section concerns the use of the soils for cultivated crops and for pasture, both as dryland and under irrigation. It includes an explanation of the capability classification of soils, discussions of management of dryland and irrigated soils by capability units, and estimates of yields of the common crops and pasture plants.

The second part concerns management of rangeland. The system of appraising native range is explained, and the several range sites in which the soils have been grouped are described.

The third part concerns use of the soils for woodland and windbreaks. The fourth concerns use of the soils as habitats for wildlife, and the fifth gives information significant in engineering uses of the soils.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops or to rice and other crops that have special requirements. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or o her characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all the soils are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that restrict the choice of plants, require very careful management, or both.
- Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover. (None in this county.)
- Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None in this county.)

Capability Subclasses are groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIe–2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit.

Management by Capability Units

All the soils of Thayer County have been placed in dryland capability units in accordance with their relative suitability for farming without irrigation. Those soils that are suitable for irrigation and are so located that enough water is available have been placed in a second set of capability units according to their suitability for irrigated crops. The soils assigned to each unit can be identified by referring to the "Guide to Mapping Units" at the back of this publication. The capability units are not numbered consecutively within the subclasses, because they fit into the statewide system of capability classification, and not all of the capability units in the State are represented in this county.

Dryland capability units [1]

Unirrigated cultivated soils in Thayer County need management that conserves moisture, preserves tilth and fertility, and controls erosion. The applicable management practices include minimum tillage, terracing and contour farming, fertilization, and the use of conservation cropping systems.

Limiting tillage operations to those essential for production of crops reduces loss of moisture through evaporation. Till-planting of row crops is one method of limiting the number of operations. Seeding grass in untilled fields of sorghum stubble is another. Crete silt loam and Crete, Hastings, and Geary silty clay loam especially need management that minimizes the loss of moisture.

Terracing and contour farming help to control erosion and conserve moisture by intercepting runoff. Only small areas in Thayer County are suitable for level terraces. Terraces on Hastings, Geary, and Crete soils are slightly lower at one end, so that water can drain into natural drainageways that have been seeded to grasses so they will not erode. Large terraces (diversions) are needed where large amounts of runoff must be channeled away safely. Both the diversions and the waterways into which they drain are grassed.

Most of the soils of the county need nitrogen, and the eroded soils need phosphorus. Deficiencies in potassium are unusual. Zinc and iron are likely to be needed if the surface layer has been removed, either by erosion or in grading. Fertilizer should be applied in the amounts needed for a particular crop, as indicated by soil tests. Arrangements for soil testing can be made with the Nebraska Agricultural Experiment Station at Lincoln. To get the greatest benefit from fertilizer, it is important to maintain a balance between the amount of fertilizer applied and the moisture content of the soil.

Applications of fertilizer and barnyard manure on soils used for cultivated crops result in increased and more rapid growth of vegetation. The additional and earlier vegetative growth helps to control erosion and increases the amount of crop residue.

A suitable cropping system supplements other measures in providing protection against erosion and against deterioration of the soils. It also helps to control weeds, insects, and diseases. It is important that cropping systems used in this county include crops that leave a good supply of long-lasting residue. Grain sorghum, wheat, and corn are examples. For the level soils, the crop sequence can consist mainly of row crops and small grains. An example of a suitable sequence for the level areas of Crete and Hastings soils is a row crop for 3 years, then 1 year of fallow, then 2 or 3 years of winter wheat. The year of fallow allows moisture to accumulate in the soils. Soils that are sloping or eroded need a cropping system that is mostly grasses and legumes. Sandy soils—Cass very fine sandy loam and Cass fine sandy loam, for example—need a system that insures a cover of residue, especially in winter and the early part of spring, when blowing is most likely.

Some of the soils in the county that are being used for crops ought to be seeded to native grasses and used for range. These include the soils of the Jansen-Meadin complexes and the severely eroded Geary silty clay loams and Wakeen and Kipp silty clay loams.

In the following pages each of the dryland capability units is described, and suitable uses and management practices for the soils of each unit are discussed.

DRYLAND CAPABILITY UNIT I-1

This unit consists of deep, nearly level soils of the Detroit, Hastings, Hobbs, Lamo, and Muir series. These soils occur on bottom lands, stream terraces, and uplands. They are medium textured or moderately fine textured and are easily worked. They absorb water readily and have a high moisture-holding capacity.

These soils are suited to wheat (fig. 10), corn, grain sorghum, and alfalfa. Because of the high moisture-holding capacity, they are used mostly for corn, grain sorghum, and alfalfa. A cropping sequence that includes frequent use of legumes helps to maintain fertility and tilth. An example of a suitable cropping sequence is 5 to 6 years of row crops, 1 year of oats, barley, or other small grain as a nurse crop, then 4 to 5 years of alfalfa.

***Figure 10.*—Wheat and corn on Hobbs silt loam, seldom flooded, which is in dryland capability unit I-1.**

These soils are also suitable for garden crops, truck crops, and orchard crops, and they will support trees for windbreaks. Grassed field borders provide turn-around areas for farm machinery and nesting places for pheasant.

If fertility is maintained, these soils can be farmed intensively without risk of damage. Commercial fertilizer, especially nitrogen, is likely to give good response.

[1] By E. O. PETERSON, conservation agronomist, Soil Conservation Service.

DRYLAND CAPABILITY UNIT IIe-1

This unit consists of deep, gently sloping soils of the Hastings, Hobbs and Muir series. These soils occur on uplands, stream terraces, and colluvial slopes. They are medium textured or moderately fine textured and are easily worked. They absorb and store water readily.

These soils are suited to corn, grain sorghum, wheat, and alfalfa. Wheat, corn, and grain sorghum are the most common crops. Row crops should not be grown more than 4 or 5 years in succession. Cropping sequences should include small grains, fallow, and alfalfa. Some farmers allow a season of fallow before a wheat crop. Lack of rainfall usually limits yields. Erosion can be controlled by a combination of terraces, contour farming, and grassed waterways.

These soils are also suitable for trees and for pasture, and they provide habitats for wildlife.

These soils need some protection against erosion. Contour farming alone is usually adequate for control of water erosion. Terraces, in conjunction with contour farming, help to control erosion and to conserve moisture. Minimum tillage and good management of crop residue on fallow fields help to conserve moisture and to control both wind and water erosion.

DRYLAND CAPABILITY UNIT IIe-2

This unit consists of Crete silt loam, 1 to 3 percent slopes, a deep soil on uplands. The subsoil is a slowly permeable claypan that restricts the movement of water and the growth of roots.

Wheat, grain sorghum, corn, alfalfa, and grasses are suitable crops. Of these, wheat is best suited, because it matures before the driest and warmest part of the summer. Grain sorghum is more reliable than corn. If the moisture supply is adequate, wheat can be grown 2 years in succession, and followed by a crop of grain sorghum.

Conserving moisture helps to increase yields. Contour farming and terracing, where possible, check runoff and control erosion and help to hold water until it can be absorbed. A cover or mulch also helps to prevent loss of moisture, especially in fall and winter.

DRYLAND CAPABILITY UNIT IIw-2

This unit consists of Butler silt loam, a moderately wet soil that has a claypan. This soil occurs in slight depressions. The surface soil is easily worked and absorbs water readily. The subsoil is fine textured and does not absorb water well; consequently, the surface layer is excessively wet for short periods. The wetness delays tillage and retards crop growth, but a complete crop loss is infrequent. This soil is sometimes droughty, especially in dry weather.

Wheat, corn, grain sorghum, and alfalfa are suitable crops. Of these, wheat and grain sorghum are best suited. An example of a suitable cropping sequence is 3 to 4 years of row crops, then small grain and legumes.

DRYLAND CAPABILITY UNIT IIw-3

This unit consists of deep, nearly level soils of the Cass and Hobbs series. These soils occur on bottom lands, and they are flooded occasionally for short periods. Crops are damaged by scouring and by sedimentation, but in dry years they benefit from the extra moisture. Tillage and planting sometimes have to be delayed because of wetness. Water is absorbed rapidly and released readily to plants. Erosion is not a problem.

Wheat, corn, grain sorghum, and alfalfa are suitable crops. Corn, grain sorghum, and alfalfa are better suited than wheat. Wheat crops are sometimes ruined by floods resulting from heavy rain early in summer. Row crops should be grown not more than 4 or 5 years in succession, and the cropping sequence should include alfalfa or some other legume.

Where outlets are available, the flood hazard can be reduced or eliminated by means of diversions, surface drainage, retention structures, and terraces on higher lying soils.

Crops respond well to fertilizer.

DRYLAND CAPABILITY UNIT IIw-4

This unit consists of Lamo silty clay loam, a deep, nearly level soil that is wet part of the year because of a seasonal high water table. This soil occurs on bottom lands and low terraces adjacent to upland deposits of loess. It is medium textured or moderately fine textured. The depth to the water table fluctuates between 2 and 6 feet. Wetness keeps these soils cooler than the drier soils in the area. Erosion is not a problem.

Corn and wheat are suitable crops, and alfalfa can be grown if the water table is lowered by artificial drainage. An example of a suitable cropping system is 4 or 5 years of corn, then several years of small grain.

Where outlets are available, it is possible to lower the water table by means of tile or open ditches. The source of the ground water should be determined before a drainage system is installed.

Crops respond to fertilizer. Nitrogen is the element most likely to be needed.

DRYLAND CAPABILITY UNIT IIw-6

This unit consists of Cass fine sandy loam, a deep, moderately coarse textured soil on bottom lands. This soil is flooded occasionally for short periods, and crops are damaged by scouring or by sedimentation. Erosion is not a problem.

Wheat, grain sorghum, corn, and alfalfa are suitable crops. Grain sorghum and alfalfa are better suited than wheat and corn. A suitable cropping system is 4 or 5 years of row crops, 1 year or more of small grain, and 4 or 5 years of alfalfa as a hay crop. A cover of vegetation should be maintained because the surface layer is susceptible to blowing if exposed during a high wind.

Where suitable outlets are available, the hazard of flooding can be reduced by terracing higher lying soils, by diverting runoff, by installing ditches or structures to drain the surface, and by building water-retarding structures.

This soil is deficient in plant nutrients, especially nitrogen and phosphorus.

DRYLAND CAPABILITY UNIT IIs-2

This unit consists of Crete silt loam, 0 to 1 percent slopes, a deep soil on uplands and stream terraces. The subsoil is a slowly permeable claypan that restricts the movement of water and the growth of roots. This soil is not subject to water erosion.

Wheat, corn, grain sorghum, and alfalfa are suitable crops. Wheat and grain sorghum are better suited than corn and alfalfa, and they can be grown several years in succession if the moisture supply is adequate.

Moisture can be conserved by minimum tillage and by keeping crop residue on the surface. These practices help the soil to absorb moisture and minimize loss from evaporation. Yields of wheat can be increased, especially in drier years, by summer fallowing.

DRYLAND CAPABILITY IIIe-1

This unit consists of deep, gently sloping soils of the Geary, Hastings, and Muir series. These soils are on uplands and benches (fig. 11). They are slightly to moderately eroded. Their slope is 3 to 7 percent. They absorb moisture readily and hold a good supply available to plants.

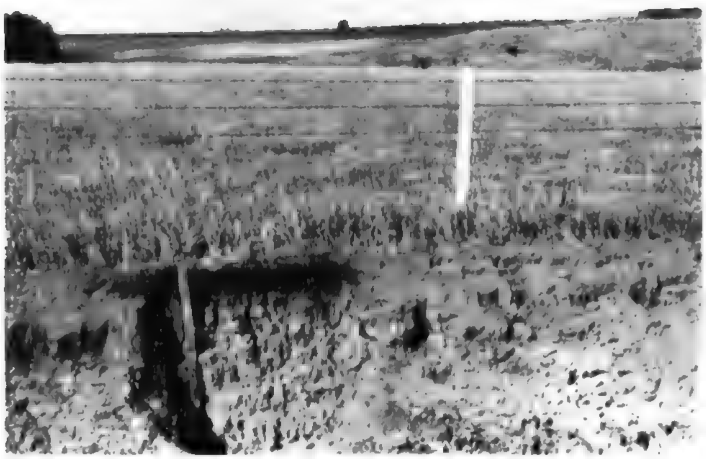

Figure 11.—**An area of Hastings silty clay loam, 3 to 7 percent slopes, eroded, used for pasture.**

Corn, wheat, grain sorghum, and alfalfa are suitable crops. Cropping systems should limit row crops to 2 or 3 consecutive years because the hard rainstorms that are prevalent in May and June wash away the soil before the young plants are large enough to make effective cover. More of the acreage should be used for alfalfa or other hay. Grass seeded with alfalfa makes a sod crop that is resistant to erosion.

Erosion of these soils can be controlled by a combination of terraces, contour farming, and grassed waterways. Moisture can be conserved by leaving crop residue on the surface. Minimum tillage and good management of crop residue while the soils are fallow help to limit soil loss and conserve moisture.

Fertilizer is needed. It is unlikely that legumes can be grown often enough to supply enough nitrogen for grain crops.

DRYLAND CAPABILITY UNIT IIIe-2

This unit consists of Crete silty clay loam, 3 to 7 percent slopes, eroded, a deep soil that has a claypan. Although the surface layer absorbs water readily, this soil is droughty because the subsoil is fine textured.

Grain sorghum, corn, wheat, and alfalfa are suitable crops. Of these, wheat and grain sorghum are the best suited. The cropping sequence should include small grain and alfalfa or other hay crops. Row crops should not be grown more than 2 or 3 years in succession.

This soil needs protection against further erosion. Conservation practices needed are terracing, contour farming, and keeping grass in waterways. Crop residue should be left on the surface. Minimum tillage and good management of crop residue while the soil is fallow help to improve water intake and increase the available moisture capacity.

Fertilizer containing zinc should be applied in terrace channel cuts, and phosphorus should be added if legumes are grown.

DRYLAND CAPABILITY UNIT IIIe-3

This unit consists of Muir-Meadin complex, 0 to 3 percent slopes, which is made up of deep, silty soils and shallow, sandy soils that overlie sand and gravel. These soils are moderately fine textured to moderately coarse textured. They occur on fans and foot slopes. They are excessively drained and have low moisture-holding capacity. Fertility is low, and the organic-matter content is low.

Grain sorghum, corn, wheat, alfalfa, and grasses are suited to these soils. Grain sorghum, wheat, and grasses do not need as much water as corn and alfalfa; consequently, they are better suited to these excessively drained soils. The cropping sequence should consist mostly of hay and small grain, and row crops should be grown only occasionally.

Crop residue should be utilized to supply organic matter. Keeping crop residue on the surface helps to control wind erosion. In some areas diversions are needed for control of runoff.

Nitrogen is needed to maintain satisfactory yields of grain. Phosphorus increases yields of alfalfa and other hay crops.

DRYLAND CAPABILITY UNIT IIIw-2

This unit consists of Fillmore silt loam, a somewhat poorly drained soil that has a claypan. This soil occurs in depressions on uplands. It is flooded occasionally. The surface layer is medium textured. The subsoil is dense and fine textured; it restricts the penetration of roots and moisture. Crops are sometimes lost because of flooding and lack of surface drainage. In some years when rainfall is heavy, these soils are too wet to cultivate.

Corn, grain sorghum, wheat, and grasses are suited to this soil. Yields of corn, grain sorghum, and wheat are best in dry years. In wet years, when flooding is severe, water-tolerant grasses are the most suitable crop. Reed canarygrass can be grown even if the soil is under water a part of the year. A suitable cropping sequence includes 3 to 4 years of row crops in succession, followed by small grain and legumes. If forage crops are grown, they should be removed from the fields soon after they are mowed, to prevent loss in case of sudden flooding.

Control of flooding is difficult. In some places the amount of runoff received can be reduced by a combination of terraces, diversions, and contour farming on the higher adjacent areas. A shallow basin in the center of a depression provides a place for surface water to drain into and makes the surrounding soil dry enough for cultivation.

DRYLAND CAPABILITY UNIT IVe-1

This unit consists of deep and moderately deep, moderately fine textured soils of the Geary, Hastings, Jansen, Kipp, Meadin, and Wakeen series. These soils occur on uplands, mainly on ridges and on side slopes of intermittent drainageways. They absorb moisture readily and retain it well. There is a serious hazard of sheet and gully erosion because surface runoff is rapid.

Grain sorghum, corn, wheat, alfalfa, and grasses are suitable crops. Wheat, alfalfa, and grasses are the best

suited of these. The cropping sequence should include a minimum of row crops. An example of a suitable cropping sequence is 1 year of corn or grain sorghum, then several years of small grain and of hay. Grass should be planted with alfalfa, for control of erosion. Areas that adjoin native grassland should be seeded to grasses and converted to grazing land.

Control of erosion is the most serious of the management problems. Intensive conservation practices are needed. Terraces, contour farming, grassed waterways, use of crop residue, and minimum tillage are all needed. Zinc is needed in some of the most eroded areas and in terrace channels and waterways.

DRYLAND CAPABILITY UNIT IVe-8

This unit consists of deep and moderately deep, well-drained, moderately fine textured soils of the Geary, Hastings, Jansen, Kipp, Lancaster, Meadin, and Wakeen series. These soils occur mainly on ridges and on side slopes of intermittent drainageways. They are severely eroded. Their slope is 7 to 11 percent. They absorb moisture readily and store it well. Nearly all of the surface soil has been removed by erosion, and there is a serious hazard of further sheet and gully erosion.

Grain sorghum, corn, wheat, alfalfa, and grasses are suitable crops. Grain sorghum is better suited than corn. An example of a suitable cropping sequence is 4 or 5 years of an alfalfa-grass mixture, 1 year of a row crop, and several years of small grain. A sequence that does not include any row crops is better.

A combination of erosion control methods is needed on these soils. Practices needed are terracing, keeping grass in waterways, and contour farming. Minimum tillage and the maximum use of crop residue also help to control erosion. Barnyard manure should be used if available; it makes the soil more friable and helps to control erosion. Nitrogen, phosphorus, and zinc are the plant nutrients most likely to be needed.

If water for livestock is available, the conversion of these soils to grassland should be considered. A cover of native grass would provide protection against erosion.

DRYLAND CAPABILITY UNIT IVw-2

This unit consists of Scott soils, which are nearly level and occur in upland depressions. These soils are flooded frequently. They have a thin surface layer of silt loam in most places, and a dense, dark-colored subsoil that contains a claypan. These soils absorb water slowly and release it to plants slowly. Wetness during part or all of the year is the main problem. Surface drainage is difficult because the depressions have no drainage outlets.

These soils are not suited to crops. Reed canarygrass can be grown in wet years, even though the soils are flooded. Cutting the hay and getting it out of the depressions and into storage is a problem. In the drier years wheat or grain sorghum can be grown in some of the areas, but again, harvesting and planting are problems.

If these soils are seeded to grasses, they can be used as wildlife habitats. Fertilizer is ordinarily not used on these soils.

DRYLAND CAPABILITY UNIT VIe-1

This unit consists of deep and moderately deep, moderately fine textured soils of the Geary, Jansen, Meadin, and Wakeen series, and areas of Breaks-Alluvial land complex. The soils of this unit developed in loess. They are slightly eroded. Their slope is 11 to 30 percent. They are not suitable for cultivation and should be left in native grasses. Although they absorb water well, the runoff is very rapid and gullies may develop. A vigorous stand of vegetation helps to check runoff and control erosion.

These soils are too steep and too erodible for cultivation. They are best suited to native grasses for hay or grazing. Range management of the existing grassland to maintain a good cover of grass is the best way to check runoff, control erosion, and conserve moisture.

These soils can be used for woodland or for wildlife habitats. Many sites can be used for flood-detention reservoirs, gully-control structures, and stockwater ponds.

DRYLAND CAPABILITY UNIT VIe-8

This unit consists mainly of deep to shallow, moderately fine textured soils of the Geary, Jansen, and Meadin series. These soils are severely eroded. Their slope is 11 to 30 percent. Water is not absorbed readily. Runoff is very rapid, and gully erosion is severe. Fertility is low, and the organic-matter content is low.

These soils are too steep and too susceptible to water erosion to be suitable for cultivation. They are best suited to native prairie grasses. The main management problem is keeping an adequate ground cover on the soils, both while vegetation is being established and while it is used for grazing. Grain sorghum and sudangrass, planted for cover the year before, provide an erosion-resistant seedbed for grass.

DRYLAND CAPABILITY UNIT VIw-1

This unit consists of Silty alluvial land, which occurs on bottom lands. It is not suitable for cultivation, because it is frequently flooded or is broken into small areas by steep streambanks and crooked channels. The areas along large intermittent streams support a fair stand of grasses. Also included are old channels just a few feet above the streambeds of perennial streams. These areas support very little vegetation.

These areas are suitable for grazing land. If the grasses are allowed to reseed, existing stands will thicken. In areas not shaded by trees, a thin stand of vegetation can be improved by seeding reed canarygrass.

DRYLAND CAPABILITY UNIT VIs-4

This unit consists of shallow soils (fig. 12) of the Kipson and Meadin series that developed in medium-textured loess or residual material overlying gravel or limestone bedrock. In areas where the underlying material is gravel, the slope ranges from 3 to 30 percent. In areas where the underlying material is limestone, the slope is 7 to 30 percent. Water is absorbed readily, but little is stored for plants. The soils overlying gravel are more droughty and less stable than those overlying limestone.

These soils are suited only to native grasses, and most of the acreage is so used. Areas that are now cultivated should be reseeded to a mixture of these grasses. Grazing should be controlled on both native grassland and reseeded areas, so that at least half of each year's growth is left on the ground as a mulch.

DRYLAND CAPABILITY UNIT VIIs-3

This unit consists of Sandy alluvial land, which is made up mostly of recently deposited sandy sediments along the

Figure 12.—An area of Kipson soils, 11 to 30 percent slopes. These soils are shallow over limestone residuum.

banks of flowing streams and in old stream channels. The soil material ranges from sandy loam to loamy sand over gravel. These areas are not suitable for cultivation, but the more stabilized areas support sparse stands of annual weeds, common reedgrasses, and trees. They are suitable for wildlife habitats and for limited grazing.

Irrigated capability units

The irrigated soils of Thayer County are mainly on the level tablelands in the northern and western parts of the county. Most of the water for irrigation is obtained from deep wells. In 1964, there were 484 irrigation wells in the county, and 45,800 acres was under irrigation (*4*).[2] Water for some small areas is supplied by pumping plants along the major flowing streams.

Different methods of irrigation are used on different soils and for different crops. Row crops grown on Crete and Hastings soils are most commonly irrigated by the furrow method. Water is delivered to the furrows by gated pipes or siphons in very gently sloping areas, but where the down-row slope is more than 1 percent, contour benches or contour furrows are necessary.

Sprinkler irrigation is suitable for the sloping and irregular areas of Crete, Hastings, and Geary soils that could be leveled only at considerable cost. Sprinklers are useful in establishing pasture on sloping soils and for other special conservation purposes, because the application of water can be controlled carefully.

Crops need to be irrigated at regular intervals during the growing season. The length of time between irrigations depends on the kind of crop and the amount of rainfall absorbed by the soil. The rate of application is governed by the rate at which the soil absorbs water, and the amount to be applied at one irrigation depends on the moisture-holding capacity of the soil. The furrow intake rate of Crete silt loam that has a slope of half of 1 percent is about 0.4 gallon per minute; that of Hastings silt loam is 0.6 gallon per minute. A Hastings soil holds 2 inches of water per foot of soil depth, that is, about 12 inches to a depth of 6 feet. Cass fine sandy loam holds less than 7 inches to a depth of 6 feet. Irrigation should begin when the moisture content of the soil is about half of the soil's capacity.

[2] Italic numbers in parentheses refer to Literature Cited, p. 51.

Corn is the main irrigated crop. Grain sorghum and alfalfa are important ones also. Corn and grain sorghum are grown in rows 40 inches apart and are irrigated by the furrow method. Alfalfa is irrigated by the sprinkler, corrugation, or flooding method.

Irrigated crops use more plant nutrients, especially more nitrogen and phosphorus, than dryland crops do. Most grain crops respond to applications of nitrogen. Where the surface layer has been removed in leveling, phosphorus and zinc are generally needed and barnyard manure and extra crop residue are beneficial.

In the following pages each of the irrigated capability units is described and the use and management of the soils of each group are discussed.

IRRIGATED CAPABILITY UNIT I-1

This unit consists of deep, silty, nearly level soils of the Cass, Detroit, Hastings, Hobbs, Lamo, and Muir series. These soils occur on bottom lands, stream terraces, and uplands. They are medium textured or moderately fine textured and are easily worked. They absorb water readily and store it well. Natural fertility is high. Some of the soils are flooded occasionally for short periods after heavy rainfall.

These soils have a moisture-holding zone of 6 feet. The moisture-holding capacity is about 2 inches per foot of depth. The water-intake rate for flood irrigation is about 0.5 inch per hour. Sprinkler or furrow methods of irrigation are well suited. The method used should be adjusted to suit the crop.

These soils are suited to corn, grain sorghum, alfalfa, and grasses.

IRRIGATED CAPABILITY UNIT IIe-1

This unit consists of deep, very gently sloping soils of the Hastings, Hobbs, and Muir series. These soils occur on stream terraces and uplands. They have a surface layer of dark-colored silt loam and a subsoil of silt loam or silty clay loam. Their substratum is silty loess or alluvium. They are slightly to moderately eroded. They absorb water well and release it readily to plants. Simple conservation practices are necessary to check runoff and control erosion.

The moisture-holding capacity to a depth of 6 feet is about 12 inches. The water-intake rate on hay crops is about 0.5 inch per hour, under flooding or sprinkler systems.

These soils are suited to all of the crops grown under irrigation in the county. Corn and sorghum are the main crops.

These soils are sloping, and irrigation water and runoff from natural rainfall can cause erosion. Planting corn and sorghum in contour rows helps to control runoff. Terraces can be used to supplement the contour rows. Bench leveling is a better method of controlling erosion, and the benches also help to conserve moisture.

IRRIGATED CAPABILITY UNIT IIe-3

This unit consists of deep and moderately deep, nearly level or very gently sloping soils of the Cass, Meadin, and Muir series. These soils occur on bottom lands, foot slopes, and stream terraces. They are easy to work. They have a surface layer of fine sandy loam or sandy loam and a subsoil of fine sandy loam. Their substratum varies widely from place to place. They are medium to low in organic-

matter content and respond well to fertilizer. Air and water move freely. Areas that have a coarse substratum close to the surface need frequent irrigation. The Cass soil in this unit is flooded occasionally for short periods by stream overflow after heavy rainfall.

The moisture-holding capacity to a depth of 4 feet is about 5 inches. The water-intake rate on hay crops is about 0.8 inch per hour, under flood or sprinkler irrigation.

These soils are suited to corn, sorghum, and alfalfa.

IRRIGATED CAPABILITY UNIT IIs-2

This unit consists of deep, nearly level soils of the Butler, Crete, and Fillmore series. These soils occur on uplands and in upland depressions. They have a medium-textured surface layer, a subsoil of silty clay or clay, and a medium-textured substratum. The surface layer absorbs water readily, but the subsoil contains a claypan that restricts the movement of water and the development of roots. Most of the areas have good natural surface drainage, but some receive runoff from higher lying soils. Spring planting in some of the areas in depressions has to be delayed in some years because of wetness. Disposal of excess water, either from irrigation or from rainfall, is the main management problem.

The moisture-holding capacity within the rooting depth of corn is about 12.5 inches. The water-intake rate on hay crops is about 0.4 inch per hour, under flood or sprinkler irrigation. Adjusting the length of the irrigation runs is essential, to prevent waste of water.

These soils are suited to all of the irrigated crops commonly grown in the county. Corn and grain sorghum are the main crops. If 3 or 4 years of alfalfa is included in the cropping sequence every 6 to 10 years, movement of water through the soil improves significantly because alfalfa roots make channels that water can seep through into the lower layers of the soil.

IRRIGATED CAPABILITY UNIT IIw-4

This unit consists of Lamo silty clay loam, a deep, nearly level, somewhat poorly drained soil on bottom lands. The surface layer and the subsoil are silty clay loam. In most places the substratum is moderately fine textured alluvium, but in some areas it is a sandy loam. The depth to the water table fluctuates between 2 and 5 feet. Wetness is the main hazard; it delays spring preparation of a seedbed in most years. If drainage outlets are available, the water table can be lowered by installing tile drains or deep open ditches.

This soil has a rooting zone of only about 3 feet, because of the fluctuating water table. The moisture-holding capacity is only about 6 inches. This low capacity to hold water necessitates frequent light irrigation. The water-intake rate on hay crops is about 0.4 inch per hour, under sprinkler or flood irrigation.

This soil is suited to corn, sorghum, and grass.

IRRIGATED CAPABILITY UNIT IIIe-1

This unit consists of deep, gently sloping soils of the Geary, Hastings, and Muir series. These soils occur on stream terraces and uplands. They are slightly to severely eroded. Their surface layer is silt loam or silty clay loam, and their subsoil is silty clay loam or silt loam. In most places their substratum is silty loess or alluvium. They are easily worked. They absorb water well and release it readily to plants. Surface runoff is moderately rapid, and conservation practices are needed to control erosion.

The moisture-holding capacity of these soils to a depth of 6 feet is about 12 inches. The water-intake rate on hayland is about 0.4 inch per hour, under flood or sprinkler irrigation.

These soils are suited to corn, sorghum, alfalfa, and grasses. If row crops are grown, the rows should be laid out on the contour. Terraces can be used to supplement the contour rows. Bench leveling controls erosion and conserves water.

IRRIGATED CAPABILITY UNIT IIIe-2

This unit consists of upland soils of the Crete series. These soils have a dark-colored surface layer and either a clayey subsoil or a claypan in the subsoil. These soils are easily worked. They absorb moisture well, but the fine-textured subsoil restricts the movement of air and water. Surface runoff is rapid, and the erosion hazard is slight to moderate.

The moisture-holding capacity of these soils to a depth of 6 feet is about 12.5 inches. The water-intake rate on hayland is about 0.4 inch per hour, under sprinkler or flood irrigation.

These soils are suited to corn, sorghum, alfalfa, and grass. A cropping sequence that includes a crop of alfalfa at intervals of 3 to 6 years helps to improve the movement of water through the profile.

The main management problems are control of erosion, conservation of water, and maintenance of fertility. Erosion can be controlled and moisture can be conserved by construction of terraces, leveling of benches, and contour irrigation.

Predicted Yields

Table 2 lists for each soil the predicted average yields per acre of the principal crops grown in Thayer County, under two levels of management. The estimates are averages per seeded acre for a 10-year period. They are based on observations and comparisons made by farmers and agricultural leaders who are familiar with the soils and agriculture of the county. They take into account the years when the moisture supply is plentiful and years when it is not. They also take into account the probable loss caused by hail and insects.

The figures in columns A of table 2 represent yields that can be expected under common management. Those in columns B represent yields that can be expected under improved management.

It is assumed that under common management—

1. Moderate amounts of fertilizer and lime are used, but the nitrogen content of the soil is low.
2. The organic-matter content of the soil is low, and soil tilth is not maintained at a high level.
3. More erosion control practices are needed.
4. Certified seed is not always used.
5. Weeds, insects, and disease are not controlled.

It is assumed that under improved management—

1. Lime, phosphorus, and nitrogen are applied in quantities indicated by the results of soil tests and field experience.
2. Crop residue is returned to the soil to maintain organic-matter content and to improve tilth.

TABLE 2.—*Predicted average acre yields of principal crops*

[Dashed lines indicate that the soil or land type is not suited to the specified crop or that irrigation is not practical]

Soil	Grain sorghum				Wheat		Corn				Alfalfa			
	Dryland		Irrigated		Dryland		Dryland		Irrigated		Dryland		Irrigated	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Breaks-Alluvial land complex	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Butler silt loam	47	65	82	105	20	29	24	44	80	104	2.0	2.5	3.8	5.0
Cass very fine sandy loam (occasionally flooded)	58	78	85	113	18	27	50	66	83	111	2.5	3.5	4.0	5.5
Cass fine sandy loam (occasionally flooded)	43	62	58	83	14	19	31	47	55	78	2.2	3.3	3.6	4.6
Crete silt loam, 0 to 1 percent slopes	52	70	91	123	25	33	37	50	90	120	2.5	3.5	4.0	5.0
Crete silt loam, 1 to 3 percent slopes	48	68	85	100	23	30	34	47	80	98	2.3	3.5	3.3	4.3
Crete silty clay loam, 3 to 7 percent slopes, eroded	44	62	78	98	17	23	29	38	75	95	2.0	2.8	3.2	4.2
Detroit silt loam	62	80	90	120	23	34	50	65	90	120	2.8	3.5	4.0	5.5
Fillmore silt loam	42	58	80	102	15	25	18	38	72	90	1.8	2.5	3.4	4.4
Geary silty clay loam, 3 to 7 percent slopes, eroded	45	60	81	98	18	25	30	40	72	95	2.2	3.3	3.4	4.0
Geary silty clay loam, 7 to 11 percent slopes, eroded	34	50	---	---	15	23	24	34	---	---	1.8	2.8	---	----
Geary silty clay loam, 7 to 11 percent slopes, severely eroded	28	42	---	---	12	19	20	28	---	---	1.4	2.0	---	----
Geary silty clay loam, 11 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Geary silty clay loam, 11 to 30 percent slopes, severely eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Hastings silt loam, 3 to 7 percent slopes	48	64	83	104	20	26	33	42	75	95	2.3	3.4	3.3	4.0
Hastings silt loam, 0 to 1 percent slopes	55	74	95	125	27	34	40	52	92	122	2.8	3.5	4.0	5.5
Hastings silt loam, 1 to 3 percent slopes	51	70	87	107	23	31	36	50	82	105	2.5	3.4	3.5	4.5
Hastings silt loam, 7 to 11 percent slopes	38	55	---	---	18	27	30	40	---	---	2.0	3.1	---	----
Hastings silty clay loam, 0 to 1 percent slopes	52	72	78	104	22	32	38	50	72	94	2.5	3.2	3.8	5.2
Hastings silty clay loam, 3 to 7 percent slopes, eroded	45	60	81	98	18	24	30	40	72	95	2.2	3.3	3.4	4.0
Hastings silty clay loam, 7 to 11 percent slopes, eroded	35	52	---	---	15	23	25	35	---	---	2.0	3.1	---	----
Hastings soils, eroded	29	44	---	---	12	19	21	30	---	---	1.8	2.7	---	----
Hobbs silt loam, seldom flooded	64	81	91	121	25	36	49	62	89	120	2.7	3.8	3.0	5.8
Hobbs silt loam, occasionally flooded	56	76	88	117	18	27	45	60	85	115	2.7	3.8	3.0	5.8
Hobbs silt loam, 1 to 4 percent slopes	59	78	88	118	21	32	44	58	80	110	2.5	3.5	3.8	4.8
Jansen loam, 7 to 11 percent slopes	28	38	---	---	12	17	16	24	---	---	1.4	2.0	---	----
Jansen sandy clay loam, 7 to 11 percent slopes, eroded	20	29	---	---	8	15	12	20	---	---	1.0	1.6	---	----
Jansen-Meadin complex, 5 to 11 percent slopes	22	32	---	---	10	17	14	22	---	---	1.4	2.0	---	----
Jansen-Meadin complex, 5 to 11 percent slopes, eroded	16	28	---	---	8	15	12	20	---	---	1.2	1.8	---	----
Jansen-Meadin complex, 11 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Jansen-Meadin complex, 11 to 30 percent slopes, eroded	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Kipson soils, 11 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Lamo silty clay loam	54	75	76	88	14	22	52	73	74	86	2.8	3.8	4.5	5.5
Lamo silty clay loam, drained	58	78	82	110	21	32	56	76	80	105	2.8	3.8	4.5	5.5
Lancaster loam, 7 to 16 percent slopes, severely eroded	23	36	---	---	10	17	15	22	---	---	1.8	2.7	---	----
Meadin loam, 3 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Muir silt loam, 0 to 1 percent slopes	62	80	90	120	25	36	48	61	87	118	2.7	3.6	4.0	5.8
Muir silt loam, 1 to 3 percent slopes	59	78	88	118	21	32	44	58	80	110	2.5	3.5	3.8	4.8
Muir silt loam, 3 to 7 percent slopes, eroded	50	70	83	104	20	28	36	44	75	98	2.2	3.3	3.4	4.0
Muir-Meadin complex, 0 to 3 percent slopes	22	34	---	---	15	21	17	27	---	---	1.0	1.6	---	----
Sandy alluvial land	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Scott soils	12	22	---	---	8	14	10	20	---	---	---	---	---	----
Silty alluvial land	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Wakeen silty clay loam, 11 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	----
Wakeen and Kipp silty clay loams, 7 to 11 percent slopes	36	58	---	---	17	25	28	38	---	---	2.2	3.2	---	----
Wakeen and Kipp silty clay loams, 7 to 11 percent slopes, severely eroded	25	38	---	---	12	17	17	26	---	---	2.0	2.8	---	----

3. The soils are drained where necessary, and erosion is controlled.
4. Certified seed is used, and stands are adequate.
5. Weeds, insects, and disease are controlled.
6. Tillage is adequate and timely.
7. Crops are grown in suitable sequences.

Range Management[3]

Rangeland makes up about 20 percent of the agricultural acreage of Thayer County. Areas throughout the county are used for range, but the largest are in the southeastern and south-central parts of the county. Most of the rangeland is not suitable for cultivation.

Range sites and condition classes

Different kinds of rangeland produce different kinds and amounts of native grass. For proper range management, an operator should know the different kinds of soils or range sites in his holdings and the kinds of plants suited to each site.

Range sites are distinctive kinds of rangeland, each of which produces a significantly different kind and amount of climax vegetation. A significant difference is one that necessitates a difference in management to maintain or improve the present vegetation. Climax vegetation is the

[3] By PETER N. JENSEN, range conservationist, Soil Conservation Service.

stabilized plant community on a given site; it reproduces itself and does not change so long as the environment does not change.

Livestock seek out the more palatable and nutritious plants, and intensive grazing reduces the numbers of desirable plants. The most heavily grazed plants are referred to as *decreasers* because they are the first to be depleted by close grazing. The less palatable plants are referred to as *increasers* because they withstand intensive grazing and replace the more desirable plants. Weeds and other plants that invade the site after the climax vegetation has been reduced are referred to as *invaders*.

Range condition refers to the percentage of climax vegetation on a range site in terms of what the site is capable of producing. Changes in range condition result mainly from intensive grazing and drought. Four classes of range condition are defined. Range is in excellent condition if 76 to 100 percent of the stand consists of climax vegetation. It is in good condition if the percentage is between 51 and 75; in fair condition if the percentage is between 26 and 50; and in poor condition if it is 25 percent or less.

The common and scientific names of the principal range plants in Thayer County are given in the following list.

Common name	*Scientific name*
Big bluestem	*Andropogon furcatus.*
Blue grama	*Bouteloua gracilis.*
Broom snakeweed	*Gutierrezia sarothrae.*
Buffalograss	*Buchloe dactyloides.*
Canada wildrye	*Elymus canadensis.*
Foxtail barley	*Hordeum jubatum.*
Hairy grama	*Bouteloua hirsuta.*
Indiangrass	*Sorghastrum nutans.*
Ironweed	*Vernonia spp.*
Little bluestem	*Andropogon scoparius.*
Needle-and-thread	*Stipa comata.*
Prairie cordgrass	*Spartina pectinata.*
Sand dropseed	*Sporobolus cryptandrus.*
Sedges	*Carex spp.*
Sideoats grama	*Bouteloua curtipendula.*
Switchgrass	*Panicum virgatum.*
Western ragweed	*Ambrosia psilostachya.*
Western wheatgrass	*Agropyron smithii.*

Descriptions of range sites

All of the soils of this county have been assigned to range sites. The soils that make up each range site can be identified by referring to the "Guide to Mapping Units" at the back of this publication. The range sites are described in the following pages.

SUBIRRIGATED RANGE SITE

This range site consists of Lamo silty clay loam, a nearly level soil that has a surface layer and subsoil of clay loam to silty clay loam. The water table fluctuates but is within reach of plant roots most of the growing season.

The climax vegetation is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, and prairie cordgrass. These grasses make up at least 75 percent of the plant cover. Western wheatgrass, little bluestem, and sedges are the principal increasers. Annuals, western ragweed, and foxtail barley are common invaders.

SILTY OVERFLOW RANGE SITE

This range site is made up of nearly level, bottom-land soils that have a surface layer and subsoil of very fine sandy loam to silty clay loam. These soils receive additional water from periodic stream overflow or as runoff from higher lying soils. They have a high moisture-holding capacity.

In the climax vegetation is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, and Canada wildrye. These grasses make up at least 75 percent of the plant cover. Western wheatgrass, little bluestem, and sedges are the principal increasers. Annuals, western ragweed, and foxtail barley are common invaders.

CLAYEY OVERFLOW RANGE SITE

This range site consists of nearly level soils on bottom lands and in upland depressions. These soils have a surface layer of silt loam to clay and a subsoil of silty clay to clay. They receive additional water from periodic stream overflow and as runoff from higher lying soils. Surface runoff is slow.

In the climax vegetation is a mixture of such decreaser grasses as big bluestem, indiangrass, prairie cordgrass, and switchgrass. These grasses make up at least 65 percent of the plant cover. Western wheatgrass and sedges are the principal increasers. Annuals and western ragweed are common invaders.

SILTY LOWLAND RANGE SITE

This range site consists of level to nearly level soils on bottom lands, terraces, and foot slopes. These soils have a surface layer and subsoil of very fine sandy loam to silty clay loam. They receive additional water in the form of runoff from higher lying soils, but they are seldom flooded.

In the climax vegetation is a mixture of such decreaser grasses as big bluestem, indiangrass, little bluestem, switchgrass, and Canada wildrye. These grasses make up at least 75 percent of the total plant cover. Western wheatgrass, blue grama, and sideoats grama are the principal increasers. Annuals, ironweed, woolly verbena, and western ragweed are common invaders.

SANDY LOWLAND RANGE SITE

This range site is made up of nearly level soils on bottom lands and terraces and along upland drainageways. These soils have a surface layer of sandy loam to loamy sand and a subsoil of sandy loam to fine sand. They receive additional water from periodic stream overflow. The water table is at a depth of 5 to 8 feet.

In the climax vegetation is a mixture of such decreaser grasses as indiangrass, little bluestem, sand bluestem, switchgrass, and Canada wildrye. These grasses make up at least 80 percent of the plant cover. Purple lovegrass, sand dropseed, and sedges are the principal increasers. Annuals and purpletop are common invaders.

SILTY RANGE SITE

This range site is made up of nearly level to moderately sloping upland soils that have a surface layer and subsoil of silt loam to clay loam. These soils are well drained. They are moderately permeable and have a high moisture-holding capacity.

In the climax vegetation is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, and switchgrass. These grasses make up at least 75 percent of the total plant cover. Sideoats grama, blue grama, buffalograss, and western wheatgrass are the principal increasers. Blue grama and buffalograss are the dominant grasses in

areas that have been continuously overgrazed. Annuals and western ragweed are common invaders.

CLAYEY RANGE SITE

This range site is made up of nearly level to rolling upland soils that have a surface layer of loam to silty clay loam and a subsoil of silty clay loam to clay. These soils are slowly permeable and droughty.

In the climax vegetation is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, and switchgrass. These grasses make up at least 65 percent of the plant cover. Western wheatgrass, sideoats grama, blue grama, and buffalograss are the principal increasers. Western wheatgrass and buffalograss are the dominant grasses in areas that have been continuously overgrazed. Annuals and western ragweed are common invaders.

SHALLOW TO GRAVEL RANGE SITE

This range site is made up of shallow upland soils that have a surface layer and subsoil of moderately coarse textured to coarse textured material, 10 to 20 inches deep, over coarse sand or gravel.

In the climax vegetation is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, sideoats grama, and needle-and-thread. These grasses make up at least 65 percent of the plant cover. Blue grama, hairy grama, and sand dropseed are the principal increasers. Annuals and broom snakeweed are common invaders.

SHALLOW LIMY RANGE SITE

This range site is made up of Kipson soils, 11 to 30 percent slopes. These soils occur on uplands. They are shallow and calcareous. They consist of 10 to 20 inches of silt loam over rock that is virtually impervious to plant roots. Their moisture-holding capacity is low.

In the climax vegetation is a mixture of such decreaser grasses as big bluestem, indiangrass, and switchgrass. These grasses make up at least 70 percent of the plant cover. Sideoats grama, blue grama, and hairy grama are the principal increasers. Annuals and broom snakeweed are common invaders.

Estimated annual yields by range sites

Yields of herbage vary from year to year according to the amount of rainfall and the kind of management the range has had in preceding years. Rodents and insects feed on forage plants. Trampling by livestock also takes its toll of range plants. The extent of damage varies from year to year. In some years the herbage loss from rodents and insects and from trampling is substantial.

The following list gives the estimated annual yield for each site, in pounds of air-dry herbage per acre. It is assumed that the range is in excellent condition and that rainfall is average.

Range site	*Estimated annual yield*
Subirrigated	5,500 to 6,500
Silty Overflow	4,500 to 5,500
Silty Lowland	4,000 to 5,500
Sandy Lowland	4,000 to 5,000
Clayey Overflow	3,500 to 5,000
Silty	3,500 to 4,500
Clayey	2,500 to 4,500
Shallow to Gravel	2,000 to 3,500
Shallow Limy	1,750 to 3,500

Woodland and Windbreaks[4]

All the natural woodland in Thayer County is on alluvial soils along the main streams and some of the larger tributaries, and on some of the higher soils near those streams. On the lower, wetter sites are stands of American elm, hackberry, green ash, boxelder, cottonwood, willows, and other kinds of water-tolerant trees. Walnut, hickory, and mulberry are scattered throughout the stands. The higher and drier sites, particularly those areas of soils formed in material weathered from limestone, support almost pure stands of bur oak. Boxelder and cottonwood are intermingled with the oaks at the lower elevations. Most of the wooded areas are not fenced off from adjacent cultivated fields and pastures, and consequently, most are grazed to some degree.

The native woodlands yield some fuelwood, posts, poles, and sawtimber for local use. A few high-quality walnut logs are cut, and bur oak is harvested for staves. Little income is derived from the sale of wood products.

The alluvial soils along the streams are well suited to black walnut. Once established, this valuable timber tree grows rapidly. The most successful method of establishing it is to set seedling trees or to plant stratified nuts under existing trees. Walnut must be protected from fire and from grazing, so it should be planted only if exclusioin of livestock is practical. Young trees should be pruned so that they will produce a limbfree, unforked butt log.

Windbreaks to protect farmsteads and livestock from the wind are the most important use of trees in this county. A well-designed windbreak beautifies the homestead, provides shade, protects gardens, reduces heating costs, and controls the drifting of snow in yards and driveways. It also provides habitats for songbirds and other wildlife and protection and browse for livestock.

The most desirable trees for windbreak planting are conifers—redcedar, ponderosa pine, Austrian pine, and Rocky Mountain juniper. Many broadleaf trees and shrubs can be used also. Redcedar grows about 1 foot a year. It reaches a height of 30 to 40 feet at maturity. Pines and broadleaf trees usually grow somewhat faster and are generally taller at maturity. Some trees that grow rapidly—cottonwood, for example—are short lived. Siberian elm also grows rapidly, but it is undesirable because it spreads. American elm is a poor choice, because it is susceptible to Dutch elm disease. The broadleaf trees commonly are removed from windbreaks as soon as the conifers have grown to an effective height.

Specific information on design, planting, and care of windbreaks is available from the local representatives of the Soil Conservation Service and the Extension Service.

The soils of Thayer County have been grouped according to characteristics that affect the growth of trees. The group to which each soil has been assigned is shown in the "Guide to Mapping Units" at the back of this publication. All of the soils in the same windbreak group have about the same capacity for supporting trees. These groups are briefly described in the following paragraphs, and trees and shrubs suitable for planting on the soils of each group are listed.

[4] By GEORGE W. ALLEY, woodland conservationist, Soil Conservation Service.

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SILTY TO CLAYEY WINDBREAK GROUP

This group consists of deep, well-drained, silty to clayey soils, most of which have a claypan. Trees and shrubs suitable for planting are—

Conifers: Eastern redcedar, ponderosa pine, Rocky Mountain juniper, Austrian pine, and Scotch pine.

Tall broadleaf trees: Honeylocust, green ash, and hackberry.

Low broadleaf trees: Russian mulberry and Russian-olive.

Shrubs: Cotoneaster, honeysuckle, lilac, Nanking cherry, Nemaha plum, and American plum.

MODERATELY WET WINDBREAK GROUP

This group consists of soils of bottom lands, terraces, and depressions. These soils are wet occasionally because they have a high water table or because they are flooded for short periods. Trees and shrubs suitable for planting are—

Conifers: Eastern redcedar and Austrian pine.

Tall broadleaf trees: Green ash, honeylocust, white willow, golden willow, and cottonwood.

Low broadleaf trees: Russian mulberry, diamond willow, and Russian-olive.

Shrubs: Red-osier dogwood, buffaloberry, Nemaha plum, American plum.

SHALLOW WINDBREAK GROUP

This group consists of soils that have a shallow root zone over bedrock or gravel. Trees suitable for planting are—

Conifers: Eastern redcedar.

NONPLANTABLE WINDBREAK GROUP

This group consists of steep, shallow soils on which trees are unlikely to grow. Although some of the areas assigned to this group support scattered stands of native trees and shrubs, planting of trees on the soils of this group is not likely to be successful.

Management of the Soils for Wildlife Habitats and as Recreation Areas [5]

The kinds and numbers of wildlife that find habitats in an area depend largely on the kind and distribution of vegetation that the soils produce. Wild animals are usually more numerous where the soils are fertile and the food supply is abundant than where the soils are less productive. More fish inhabit streams fed by drainage from fertile soils than inhabit streams that drain infertile soils.

The soils of this county, as they are suitable for wildlife habitats, are discussed in this section by soil associations. The associations are described more fully in the section "General Soil Map."

Topography indirectly affects the numbers of wildlife in an area because it affects the way a soil can be used. Many rough, irregularly shaped areas that are unsuitable for crops or range are suitable for wildlife habitats.

The topography of the Hastings-Geary association and the Geary-Hastings association provides odd corners that make suitable habitats for wildlife. Quail and pheasant thrive. Soils of the Hastings-Geary association are somewhat better suited than those of the Geary-Hastings association because more of the acreage is cultivated. In addition to land cover, there are sites suitable for constructing fishponds (fig. 13) and building dams. In some of these places, however, the soils are clayey enough to make pond water muddy, and special treatment is needed to keep the water clear enough for fish.

Figure 13.—A well-developed habitat around a farm pond that provides food and cover for wildlife.

The Hobbs-Muir-Cass association occurs mainly as bottom lands and stream terraces in the valleys of the Little Blue River and some of the larger creeks. The river provides some of the best fishing spots in the county, and the lower reaches of Big Sandy Creek and Rose Creek support a fair number of fish. The bottom lands along the streams are highly productive of food and cover for white-tailed deer and other kinds of deer, quail, squirrel, pheasant, and cottontail rabbits. Mink and muskrat find habitats where there are suitable watering places. The marshy areas and the open waters are used by waterfowl, especially by flocks migrating in spring and fall.

The topography of the Crete-Hastings-Butler association is nearly level to sloping, and odd corners where wildlife can find permanent habitats are scarce. Cultivated fields are generally large, and there is little variety in the kinds of cover suitable for wildlife. Wheatfields in this association provide good nesting grounds for pheasant because these birds habitually nest at the time of year when wheat is dormant, and the nests are undisturbed until after the peak of the hatch. Grain sorghum is a good source of food for pheasant.

The topography of the Jansen-Meadin association is irregular. The soils are mainly on valley side slopes along streams. They are low in fertility and produce too little food and cover to support many kinds or large numbers of wildlife. If the areas are used within their limitations, some of them provide suitable habitats, especially those areas that adjoin associations that are more suitable for wildlife.

The soils of the Kipson-Wakeen association are strongly sloping to steep. Most of the acreage is in native grassland and is used for range. Little of it is used for cultivated crops, and areas suitable for wildlife are scarce. Quail and pheasant find habitats.

[5] By CHARLES BOHART, biologist, Soil Conservation Service.

In table 3 the potential of each soil association in Thayer County for producing food and cover for wildlife is rated. Openland wildlife includes the birds and animals that normally frequent cropland, pastures, meadows, and odd areas of herbaceous vegetation. Pheasant, quail, meadowlarks, coyotes, prairie dogs, and jackrabbits are representative of this group. Woodland wildlife includes those that seek habitats in wooded or shrubby areas. White-tailed deer, squirrel, raccoon, and thrushes are representative of this group. Wetland wildlife includes those that normally frequent marshes and swamps, ponds, and the shallow waters near streambanks. Ducks, shore birds, beavers, minks, and muskrats are in this group. The fish include channel catfish, flatheads, black bass, bluegill, and crappie.

Wildlife habitats in Thayer County can be improved by protecting all existing areas of natural cover. Good vegetative cover along roadsides provides suitable nesting places for pheasant. These areas should not be burned. If mowing is delayed until after the hatching season, the number of young pheasants will increase. Wild turkey and some other kinds of wildlife could be reintroduced.

Technical assistance in planning development of areas as wildlife habitats and in planning and applying conservation practices for developing outdoor recreation facilities can be obtained from the office of the Soil Conservation Service at Hebron. Additional information and assistance can be obtained from the Nebraska Game, Forestation, and Parks Commission, from the Bureau of Sport Fisheries and Wildlife, and from the Federal Extension Service.

Engineering Properties of the Soils[6]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of highways, airports, pipelines, building foundations, earth dams for storing water and controlling erosion, irrigation systems, drainage systems, and sewage-disposal systems. The properties important to engineers are soil texture, permeability, shear strength, plasticity, moisture-density relationships, compressibility, workability, and water-holding capacity. Also important are topography, depth to the water table at all seasons, and depth to bedrock or to sand and gravel.

Information in this report can be used to—

1. Make studies that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Make preliminary estimates of the engineering properties of soils for use in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces and other structures for conserving soil and water.
3. Make preliminary evaluations that will aid in selecting locations for highways and airports and in planning detailed surveys of the soils at the site.
4. Make preliminary estimates for use in designing culverts and bridges.
5. Identify the soils along proposed routes for highways so that preliminary estimates can be made of the thickness required for flexible pavements.
6. Estimate the need for clay to stabilize the surface of unpaved roads.
7. Locate probable sources of sand, gravel, rock, mineral filler, and soil binder for use in subbase courses, base courses, and surface courses for flexible pavements for highways and airports.

[6] By JOHN E. OVERING, area engineer, and ROBERT S. POLLOCK, soil scientist, Soil Conservation Service, with the assistance of WILLIAM J. RAMSEY, field geologist, Division of Materials and Tests, Nebraska Department of Roads, and LEE E. SMEDLEY, assistant State conservation engineer, Soil Conservation Service. The work of the Nebraska Department of Roads was performed under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads.

TABLE 3.—*Potential of soil associations for producing elements of wildlife habitats*

[Dashed lines mean not applicable]

Soil association	Kind of wildlife	Potential for producing— Woody cover	Herbaceous cover	Aquatic habitat	Food
1. Hastings-Geary association.	Openland	Good	Good	----------	Good.
	Woodland	Good	Good	----------	Good.
	Fish	----------	----------	Fair	----------
2. Hobbs-Muir-Cass association.	Openland	Good	Very good	----------	Very good.
	Woodland	Very good	Very good	----------	Very good.
	Wetland	----------	----------	Good	Fair.
	Fish	----------	----------	Good	----------
3. Crete-Hastings-Butler association.	Openland	Very good	Good	----------	Very good.
	Woodland	Good	Good	----------	Good.
4. Jansen-Meadin association.	Openland	Fair	Fair	----------	Fair.
	Woodland	Fair	Fair	----------	Fair.
5. Geary-Hastings association.	Openland	Good	Good	----------	Good.
	Woodland	Good	Good	----------	Good.
	Fish	----------	----------	Fair	----------
6. Kipson-Wakeen association.	Openland	Fair	Good	----------	Fair.
	Woodland	Good	Good	----------	Fair.
	Fish	----------	----------	Fair	----------

8. Make preliminary evaluations of topography, surface drainage, subsurface drainage, height of water table, and other features that should be considered in designing highway embankments, subgrades, and pavements.
9. Correlate performance of engineering structures with soil mapping units to develop information that will be useful in designing and maintaining such structures.
10. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
11. Supplement information obtained from published maps, reports, and aerial photographs, for the purpose of making maps and reports that can be used readily by engineers.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used in this publication have a special meaning to soil scientists that may not be familiar to engineers. The Glossary defines many such terms as they are used in soil science.

Engineering classification systems

Most highway engineers classify soil materials according to the system used by the American Association of State Highway Officials (AASHO (*1*). In this system soil materials are classified into seven principal groups, designated A-1 through A-7. The best materials for engineering purposes (gravelly soils of high bearing capacity) are classified as A-1, and the poorest (clayey soils having low strength when wet) are classified as A-7. Within each group, the relative engineering value of the soils is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The group indexes for the soils that have been analyzed are given in parentheses following the group number.

Some engineers prefer the Unified soil classification system (*9*), which was developed by the Corps of Engineers, U.S. Army. In this system, soil materials are identified as coarse grained (eight classes), fine grained (six classes), or highly organic, and symbols are used to identify each group.

Engineering test data

Table 4 gives engineering test data for samples of several different soils. The samples were tested by the Division of Materials and Tests, Nebraska Department of Roads, according to standard procedures of the American Association of State Highway Officials. Each soil was sampled by natural horizons.

The soils listed in table 4 were sampled at one or more locations. The test data for a soil sampled in any one location indicates the engineering characteristics of the soil only at that particular location. The sample tested may differ considerably in engineering characteristics from the same kind of soil at other locations. The test data probably do not show the maximum range in characteristics that affect engineering. The soils tested are typical of the most extensive soils of the county.

TABLE 4.—*Engineering*

[Tests performed by the Nebraska Department of Roads in cooperation with the Bureau of Public Roads (BPR),

Soil name and location	Parent material	Nebraska report No.	Depth from surface	Horizon	Moisture-density data [1]: Maximum dry density	Moisture-density data [1]: Optimum moisture
			In.		*Lb. per cu. ft.*	*Pct.*
Butler silt loam: 0.35 mile E. and 50 feet S. of NW. corner of sec. 26, T. 4 N., R. 4 W.	Peorian loess.	S62-7985	5 to 10	A1	100	19
		S62-7986	12 to 23	B21	90	28
		S62-7987	50 to 62	C2	100	21
Cass very fine sandy loam: 0.25 mile S. and 0.1 mile E. of NW. corner of sec. 19, T. 3 N., R. 4 W.	Alluvium.	S62-7991	2 to 11	A12	105	18
		S62-7992	14 to 48	C	117	12
Crete silt loam: 0.3 mile E. and 50 feet S. of NW. corner of sec. 11, T. 3 N., R. 3 W. (modal).	Peorian loess.	S62-7998	6 to 11	A1	100	18
		S62-7999	14 to 22	B21	94	27
		S62-8000	35 to 48	C	99	20
0.2 mile N. and 50 feet E. of SW. corner of sec. 17, T. 4 N., R. 1 W. (maximal).	Peorian loess.	S62-7995	5 to 10	A1	100	18
		S62-7996	13 to 25	B21	92	26
		S62-7997	35 to 52	C	100	22

See footnotes at end of table.

The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. It is expressed as a percentage of the ovendry weight of the soil. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is in a plastic condition. Some silty and sandy soils are nonplastic; that is, they will not become plastic at any moisture content.

Estimated properties of the soils

Table 5 (p. 38) gives some of the characteristics of the soils of the county that are significant in engineering. The information in the table is based on estimates of physical properties and on test data summarized in table 4.

The permeability ratings given in table 5 refer to the rate at which water moves through undisturbed soil material. Permeability depends largely upon soil texture and structure.

The estimates of available water capacity, expressed in inches of water per inch of soil depth, refer to the water available to plants. This water is held in the range between field capacity and the wilting point.

In general, the texture of a soil indicates its shrink-swell potential. In table 5 the shrink-swell potential has been estimated as "high" for plastic silts and clays, as "low" or "moderate" for soils having a low to moderate plasticity index, and as "none" for nonplastic soils. Some of the estimates are based on comparisons with soils of known particle-size distribution or plasticity ratings.

The soils of this county are generally fine grained, but grain size varies considerably in any soil and especially in soils formed in alluvium. Consequently, it should not be assumed that all areas of a specific soil will be the same, or that the engineering classifications of a sample will be the same as those given in table 5.

The only soils in the county that contain enough salts to affect construction are those of the Lamo series. A few small areas of these soils contain enough sodium to cause moderate dispersion.

Engineering interpretations

Table 6 (p. 40) gives interpretations that are useful in planning engineering construction and agricultural practices. The soils are rated according to their suitability as a source of topsoil, sand, and sand-gravel. They are also rated according to their suitability for use as road subgrade and road fill. In addition, soil features are named that affect suitability for highway locations, foundations, dikes and levees, low dams, and other small structures. Also listed are features that affect drainage, terraces, and other agricultural practices that limit use of the soils for sewage disposal.

Generally, soil features are rated according to the seriousness of the problems they cause in the construction and maintenance of highways and agricultural structures and in carrying out agricultural practices. The soil features affecting suitability of a given soil for engineering practices are based on the characteristics of that soil as described in table 5. Ratings of the soil for use in some structures differ according to variations in the profile.

test data

in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—					Percentage smaller than—							
¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO	Unified [3]
									Pct.			
--------	------	------	100	99	90	55	26	18	33	8	A-4(8)	ML-CL.
--------	------	------	100	99	94	78	58	50	63	36	A-7-6(20)	CH.
--------	------	------	--------	100	96	65	38	27	47	24	A-7-6(15)	CL.
--------	------	100	98	68	56	39	24	17	30	11	A-6(7)	CL.
--------	------	100	97	52	42	23	8	4	19	2	A-4(3)	ML.
--------	------	------	100	99	92	49	29	20	36	12	A-6(9)	ML-CL.
--------	------	------	100	99	97	74	51	42	57	31	A-7-6(19)	CH.
--------	------	------	100	99	91	62	35	25	44	21	A-7-6(13)	CL.
--------	------	------	100	99	90	56	33	25	37	13	A-6(9)	ML-CL.
--------	------	------	100	99	95	78	52	42	64	38	A-7-7(20)	CH.
--------	------	------	100	99	94	70	32	21	40	17	A-6(11)	CL.

TABLE 4.—*Engineering*

Soil name and location	Parent material	Nebraska report No.	Depth from surface	Horizon	Moisture-density data[1]	
					Maximum dry density	Optimum moisture
			In.		*Lb. per cu. ft.*	*Pct.*
Geary silty clay loam: 0.4 mile W. of SE. corner of sec. 23, T. 1 N., R. 2 W.	Loveland loess.	S62-8019	0 to 13	A1	100	20
		S62-8020	22 to 37	B2	103	18
		S62-8021	37 to 54	C	104	19
Hastings silt loam: 0.2 mile E. and 100 feet N. of SW. corner of sec. 12, T. 4 N, R. 4 W. (modal).	Peorian loess.	S62-8004	6 to 10	A1	99	20
		S62-8005	14 to 25	B21	95	24
		S62-8006	37 to 70	C	103	22
0.3 mile S. of NE. corner of sec. 30, T. 3 N., R. 4 W. (minimal).	Peorian loess.	S62-8001	8 to 12	A1	94	21
		S62-8002	12 to 20	B21	95	25
		S62-8003	35 to 51	C1	101	20
Hobbs silt loam, occasionally flooded: 50 feet E. and 25 feet S. of NW. corner of sec. 35, T. 3 N., R. 1 W.	Alluvium.	S62-8013	0 to 6	Ap	108	16
		S62-8014	16 to 22	AC	104	17
		S62-8015	22 to 40	C	107	15
Hobbs silt loam, seldom flooded: 0.1 mile S. and 100 feet W. of E. quarter corner of sec. 23, T. 4 N., R. 4 W.	Alluvium.	S62-8025	4 to 28	A1	99	19
		S62-8026	28 to 40	AC	100	19
		S62-8027	40 to 48	C	107	16
Hobbs silt loam: 0.4 mile S. and 50 feet W. of NE. corner of sec. 23, T. 4 N., R. 4 W.	Alluvium.	S62-8010	5 to 13	A1	103	17
		S62-8011	18 to 31	Alb	99	21
		S62-8012	35 to 58	B2b	98	21
Kipson soils: 100 feet N. of SW. corner of NW¼ of sec. 32, T. 1 N., R. 1 W.	Limestone.	S62-8022	0 to 7	A11	101	20
		S62-8023	7 to 13	A12	105	16
		S62-8024	13 to 21	AC	109	16
Lamo silty clay loam: 100 feet W. and 100 feet N. of S. quarter corner of sec. 8, T. 2 N., R. 2 W.	Alluvium.	S62-8016	0 to 12	A11	101	20
		S62-8017	19 to 29	B2	103	19
		S62-8018	36 to 52	C	106	18
Meadin loam: 0.3 mile E. and 0.2 mile N. of SW. corner of sec. 10, T. 2 N., R. 2 W.	Pleistocene sands and gravel.	S62-7993	0 to 11	A1	123	10
		S62-7994	15 to 42	D	117	6
Muir silt loam: 0.1 mile S. and 50 feet W. of NE. corner of sec. 23, T. 3 N., R. 4 W.	Alluvium (terrace).	S62-8007	6 to 16	A1	105	17
		S62-8008	16 to 30	B2	96	20
		S62-8009	36 to 65	C	102	20
Wakeen silty clay loam: 0.15 mile W. of SE. corner of sec. 26, T. 3 N., R. 1 W.	Limestone.	S62-7988	0 to 7	A1	91	24
		S62-7989	7 to 16	B2	97	23
		S62-7990	22 to 26	C	98	22

[1] Based on AASHO Designation: T 99-57. Method A (*1*).
[2] Mechanical analysis according to AASHO Designation: T 88-57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not

test data—Continued

Mechanical analysis [2]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—					Percentage smaller than—						AASHO	Unified [3]
¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
									Pct.			
--------	------	------	100	97	90	45	29	22	37	15	A-6(10)	CL.
--------	------	------	100	97	88	51	36	31	44	24	A-7-6(14)	CL.
--------	------	------	100	97	90	48	32	27	38	19	A-6(12)	CL.
--------	------	------	100	99	85	53	28	20	34	10	A-4(8)	ML-CL.
--------	------	------	--------	100	94	72	49	41	58	33	A-7-6(20)	CH.
--------	------	------	--------	100	92	59	36	28	43	20	A-7-6(13)	CL.
--------	------	------	100	98	90	50	29	20	43	16	A-7-6(11)	ML-CL.
--------	------	------	100	99	94	66	46	39	51	26	A-7-6(17)	CH.
--------	------	------	100	99	93	59	32	22	40	16	A-6(10)	ML-CL.
--------	------	------	100	90	82	33	19	13	28	7	A-4(8)	ML-CL.
--------	------	------	100	96	86	32	12	10	30	4	A-4(8)	ML.
--------	------	------	100	77	52	18	9	8	23	1	A-4(8)	ML.
--------	------	------	100	94	87	51	29	21	38	16	A-6(10)	CL.
--------	------	------	100	94	87	47	27	23	37	16	A-6(10)	CL.
--------	------	------	100	86	77	39	22	19	30	10	A-4(8)	CL.
--------	------	100	99	92	86	38	22	17	32	11	A-6(8)	CL.
--------	------	------	100	96	92	50	30	21	38	16	A-6(10)	CL.
--------	------	------	100	98	93	58	39	32	46	24	A-7-6(15)	CL.
[4] 89	75	73	68	56	49	34	20	13	43	16	A-7-6(7)	ML-CL.
[4] 54	39	39	36	29	26	19	11	8	42	16	A-2-7(1)	GM-GC
[4] 79	77	76	70	58	45	34	22	16	29	9	A-4(5)	CL.
--------	------	------	100	96	90	55	31	24	43	21	A-7-6(13)	CL.
--------	------	100	98	95	92	55	38	31	51	32	A-7-6(18)	CH.
--------	------	100	99	93	88	44	27	23	41	22	A-7-6(13)	CL.
100	98	94	72	32	27	9	6	3	([5])	([5])	A-2-4(0)	SM.
100	93	80	36	3	2	2	1	0	([5])	([5])	A-1-b(0)	SW.
--------	------	------	100	93	82	36	20	14	30	7	A-4(8)	ML-CL.
--------	------	------	100	99	95	54	34	25	40	19	A-6(12)	CL.
--------	------	------	100	97	89	52	30	24	38	18	A-6(11)	CL.
--------	------	100	99	98	93	61	42	32	54	25	A-7-6(17)	MH-CH.
--------	------	100	99	95	92	68	50	40	54	29	A-7-6(18)	CH.
[6] 91	91	91	89	84	80	62	48	36	47	24	A-7-6(15)	CL.

suitable for use in naming textural classes for soils.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. An example of a borderline classification so obtained is ML-CL.

[4] One hundred percent passed the 3-inch sieve.

[5] Nonplastic.

[6] One hundred percent passed the 4-inch sieve; 95 percent passed the 3-inch sieve.

TABLE 5.—*Estimated*

[Dashed lines indicate that properties are too variable for reliable estimates to be made. Estimated

Soil series and map symbols	Underlying material [1]	Depth to water table	Depth to bedrock, sand, or sand-gravel mixture	Depth from surface
		Feet	*Feet*	*Inches*
Breaks-Alluvial land complex (By)	Silt (Peorian loess)	[3]	[4]	--------
Butler (Bu)	Silt (Peorian loess)	[3]	[4]	0 to 12 12 to 36 36 to 72
Cass (Cs)	Stratified sand and silt	4 to 12	2 to 5 (Sand)	0 to 9 9 to 28 28 to 48
Cass (Cv)	Stratified sand and silt	4 to 12	2 to 5 (Sand)	0 to 10 10 to 16 16 to 42
Crete (Ce, CeA)	Silt (Peorian loess)	[3]	[4]	0 to 10 10 to 35 35 to 52
Crete (CrB2)	Silt (Peorian loess)	[3]	[4]	0 to 6 6 to 38 38 to 48
Detroit (De)	Silt (Peorian loess)	5 to 15	10 to 20	0 to 13 13 to 32 32 to 48
Fillmore (Fm)	Silt (Peorian loess)	[3]	[4]	0 to 12 12 to 44 44 to 72
Geary (GeB2, GeC2, GeC3, GeE, and GeE3)	Silt (Loveland loess)	[3]	4 to 30	0 to 13 13 to 37 37 to 54
Hastings (Hs, HsA, HsB, and HsC)	Silt (Peorian loess)	[3]	[4]	0 to 10 10 to 37 37 to 70
Hastings (Hs2)	Loess (Peorian)	[3]	[4]	0 to 16 16 to 42
Hastings (Ht, HtB2, and HtC2)	Silt (Peorian loess)	[3]	[4]	0 to 21 21 to 42
Hobbs (Hb)	Stratified silt	5 to 15	10 to 20	0 to 38 38 to 58
Hobbs (HbA)	Stratified silt	[3]	5 to 20	0 to 72
Hobbs (2Hb)	Stratified silt	3 to 10	6 to 15	0 to 16 16 to 22 22 to 40
Jansen (JaC, JMC, JMC2, JMD, and JMD2. See Meadin series for Meadin part).	Stratified sand and gravel	[3]	3 to 5 (Sand and gravel)	0 to 17 17 to 26 26 to 52
Jansen (JsC2)	Stratified sand and gravel	[3]	3 to 5	0 to 20 20 to 52
Kipp (WKC and WKC3)	Stratified limestone and shale	[3]	[4]	0 to 8 8 to 26
Kipson (KpD)	Stratified limestone and shale	[3]	[4]	0 to 7 7 to 13
Lamo (Lb)	Stratified silt and clay	2 to 4	4 to 16	0 to 19 19 to 29 29 to 52
Lamo (2Ly)	Stratified silt and clay	4 to 10	[4]	--------
Lancaster (LcD3)	Sandstone	[3]	[4]	0 to 17 17 to 26 26

See footnotes at end of table.

engineering properties

properties of soils mapped as complexes are given under the series name of the individual components]

Classification			Percentage passing sieve—			Permeability [2]	Available water capacity	Shrink-swell potential
USDA texture	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
						Inches per hour	*Inches per inch of soil*	
--------	--------	--------	--------	--------	--------	--------	--------	--------
Silt loam	ML to CL	A-4	--------	100	95 to 100	0. 80 to 2. 5	0. 16	Low.
Silty clay	CH	A-7	--------	100	95 to 100	0. 05 to 0. 20	. 18	High.
Silt loam	CL	A-7	--------	100	95 to 100	0. 80 to 2. 5	. 16	Moderate to high.
Fine sandy loam	ML	A-4	--------	100	60 to 70	2. 5 to 5. 0	. 15	Low to moderate.
Fine sandy loam	ML to CL	A-4 or A-6	100	95 to 100	55 to 65	2. 5 to 5. 0	. 15	Low to moderate.
Loamy fine sand	SM	A-4	100	85 to 100	40 to 50	5. 0 to 10. 0	. 10	Low.
Very fine sandy loam	ML to CL	A-4 or A-6	100	95 to 100	60 to 70	0. 80 to 2. 5	. 16	Low to moderate.
Very fine sandy loam	ML to CL	A-4 or A-6	100	95 to 100	60 to 70	0. 80 to 2. 5	. 16	Low to moderate.
Loamy fine sand	SM	A-4	100	85 to 100	40 to 50	5. 0 to 10. 0	. 10	Low.
Silt loam	ML to CL	A-6	--------	100	90 to 100	0. 80 to 2. 5	. 16	Moderate.
Silty clay	CH	A-7	--------	100	95 to 100	0. 05 to 0. 20	. 18	High.
Silt loam	CL	A-6 or A-7	--------	100	90 to 100	0. 80 to 2. 5	. 16	Moderate.
Silty clay loam	CL	A-6	--------	100	95 to 100	0. 20 to 0. 80	. 17	Moderate.
Silty clay	CH	A-7	--------	100	95 to 100	0. 05 to 0. 20	. 18	High.
Silt loam	CL	A-4 or A-6	--------	100	90 to 100	0. 80 to 2. 5	. 16	Low to moderate.
Silt loam	ML to CL	A-4	--------	100	90 to 100	0. 80 to 2. 5	. 16	Low.
Silty clay loam	CL or CH	A-7	--------	100	95 to 100	0. 20 to 0. 80	. 17	Moderate to high.
Silt loam	ML to CL	A-4 or A-6	--------	100	95 to 100	0. 80 to 2. 5	. 16	Low to moderate.
Silt loam	ML to CL	A-4 or A-6	--------	100	95 to 100	0. 80 to 2. 5	. 16	Low to moderate.
Silty clay	CH	A-7	--------	100	95 to 100	0. 05 to 0. 20	. 18	High.
Silt loam	CL	A-6 or A-7	--------	100	95 to 100	0. 80 to 2. 5	. 16	Moderate to high.
Silty clay loam	CL	A-6	--------	100	95 to 100	0. 20 to 0. 80	. 17	Moderate.
Silty clay loam	CL	A-7	--------	100	95 to 100	0. 20 to 0. 80	. 17	Moderate.
Silty clay loam	CL	A-6	--------	100	95 to 100	0. 20 to 0. 80	. 17	Moderate.
Silt loam	ML or CL	A-6	--------	100	95 to 100	0. 80 to 2. 5	. 16	Moderate.
Silty clay loam	CL or CH	A-7	--------	100	97 to 100	0. 20 to 0. 80	. 17	High.
Silt loam	CL	A-6 or A-7	--------	100	97 to 100	0. 80 to 2. 5	. 16	Moderate.
Silty clay loam	CH	A-7	--------	100	95 to 100	0. 20 to 0. 80	. 17	Moderate to high.
Silt loam	CL	A-6	--------	100	95 to 100	0. 80 to 2. 5	. 16	Moderate.
Silty clay loam	CL or CH	A-6 or A-7	--------	100	97 to 100	0. 20 to 0. 80	. 17	Moderate to high.
Silt loam	CL	A-6	--------	100	97 to 100	0. 80 to 2. 5	. 16	Moderate.
Silt loam	CL	A-6	--------	100	90 to 100	0. 80 to 2. 5	. 16	Moderate.
Silt loam	CL	A-4 or A-6	--------	100	85 to 100	0. 80 to 2. 5	. 16	Low to moderate.
Silt loam	CL	A-6	100	95 to 100	90 to 100	0. 80 to 2. 5	. 16	Moderate.
Silt loam	ML or CL	A-4	--------	100	90 to 100	0. 80 to 2. 5	. 16	Low.
Very fine sandy loam	ML	A-4	--------	100	85 to 100	0. 80 to 2. 5	. 16	Low.
Silt loam	ML	A-4	--------	100	75 to 90	0. 80 to 2. 5	. 16	Low.
Loam	SM	A-4 or A-6	95 to 100	80 to 95	35 to 45	0. 80 to 2. 5	. 16	Low.
Sandy clay loam	SM to SC	A-4 or A-6	85 to 95	70 to 85	40 to 50	0. 20 to 0. 80	. 17	Low to moderate.
Sand and gravel	SP to SM	A-1	85 to 95	75 to 85	3 to 13	5. 0 to 10. 0	06	None.
Sandy clay loam	SM to SC	A-4 or A-6	85 to 100	70 to 95	35 to 50	0. 20 to 0. 80	. 17	Low to moderate.
Sand and gravel	SP to SM	A-1	85 to 95	75 to 85	3 to 13	5. 0 to 10. 0	. 06	None.
Silty clay loam	CL or CH	A-6 or A-7	--------	100	95 to 100	0. 20 to 0. 80	. 17	Moderate to high.
Silty clay	CH	A-7	--------	100	95 to 100	0. 05 to 0. 20	. 18	High.
Silt loam	ML to CL	A-6 or A-7	70 to 80	70 to 80	50 to 60	0. 80 to 2.5	. 16	Moderate.
Silty clay loam	CL	A-6 or A-7	70 to 80	70 to 80	50 to 70	0. 20 to 0. 80	. 17	Moderate.
Silty clay loam	CL	A-6 or A-7	--------	100	90 to 100	0. 20 to 0. 80	. 17	Moderate.
Silty clay loam	CL or CH	A-7	--------	100	90 to 100	0. 20 to 0. 80	. 17	Moderate.
Silty clay loam	CL	A-6 or A-7	--------	100	90 to 100	0. 20 to 0. 80	. 17	Moderate.
--------	--------	--------	--------	--------	--------	--------	--------	Moderate.
Loam	ML	A-4	100	95 to 100	85 to 95	0. 80 to 2. 5	. 16	Low to moderate.
Very fine sandy loam	ML or CL	A-4 or A-6	100	95 to 100	75 to 90	0. 80 to 2. 5	. 16	Low to moderate.
Sandstone	SP to SM	A-3 or A-2	100	95 to 100	5 to 20	0. 05 to 0. 20	. 06	None to low.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Underlying material [1]	Depth to water table	Depth to bedrock, sand, or sand-gravel mixture	Depth from surface
		Feet	*Feet*	*Inches*
Meadin (Mw)	Stratified sand and gravel	(3)	1 to 3	0 to 15 15 to 42
Muir (Mu, MuA, MuB2, and MQ. See Meadin series for Meadin part of MQ).	Stratified silt and fine sand	(3)	10 to 20	0 to 16 16 to 36 36 to 65
Sandy alluvial land (Sx)	Stratified sand and gravel	1 to 3	0 to 2	---------
Scott (Sc)	Silt (Peorian loess)	(3)	(4)	0 to 6 6 to 48 48 to 60
Silty alluvial land (Sy)	Stratified silt and sand	10 to 20	4 to 20	---------
Wakeen (WeD, WKC, WKC3. See Kipp series for Kipp part of WKC and WKC3).	Stratified limestone and shale	(3)	(4)	0 to 26

[1] Material generally at a depth between 4 feet and 10 feet.
[2] The rate at which water moves through undisturbed soil material. Ratings are expressed in words as: 0.05 to 0.20 inch per hour—slow; 0.20 to 0.80 inch per hour—moderately slow; 0.80 to 2.50 inches per hour—moderate; 2.50 to 5 inches per hour—moderately rapid; 5 to 10 inches per hour—rapid.

TABLE 6.—*Engineering*

[Interpretations for miscellaneous land types are not made, because

Soil series and map symbols	Suitability—					Soil properties that affect suitability for—		
	As a source of		Of material for			Highway location	Foundations [1]	Dikes and levees
	Topsoil	Sand or sand-gravel mixture	Road subgrade: Paved	Road subgrade: Gravel	Road fill			
Breaks-Alluvial land complex (By).	Fair	------------	--------	--------	--------	--------------	--------------	--------------
Butler (Bu)	Fair	Unsuitable	Fair to poor.	Good	Fair to poor.	High susceptibility to frost action; 4 to 7 feet of fill needed in places; erodibility.	Good to poor bearing capacity.	Not applicable
Cass (Cs and Cv)	Fair	Fair for sand below a depth of 4 feet; unsuitable for sand-gravel.	Fair to poor.	Good	Fair to poor.	Very high susceptibility to frost action; subject to overflow.	Good to poor bearing capacity; subject to piping in places.	Erodibility; subject to piping in places.
Crete (Ce, CeA, and CrB2).	Good to poor.	Unsuitable	Poor	Good	Poor	High susceptibility to frost action; erodibility.	Good to poor bearing capacity.	Not applicable

See footnote at end of table.

properties—Continued

Classification			Percentage passing sieve—			Permeability [3]	Available water capacity	Shrink-swell potential
USDA texture	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
						Inches per hour	*Inches per inch of soil*	
Loam	SM	A-2 or A-4	95 to 100	85 to 95	25 to 40	0. 80 to 2. 5	0. 16	Low.
Sand and gravel	SP to SM	A-1	85 to 95	75 to 85	3 to 13	5. 0 to 10. 0	. 06	None.
Silt loam	ML to CL	A-4		100	95 to 100	0. 80 to 2. 5	. 16	Low.
Silt loam	CL	A-6 or A-7		100	95 to 100	0. 80 to 2. 5	. 16	Moderate.
Silt loam	CL	A-6		100	95 to 100	0. 80 to 2. 5	. 16	Moderate.
Silt loam	ML to CL	A-4 or A-6		100	95 to 100	0. 80 to 2. 5	. 16	Low.
Silty clay	CH	A-7		100	95 to 100	0. 05 to 0. 20	. 18	High.
Silt loam	CL	A-7		100	95 to 100	0. 80 to 2. 5	. 16	Moderate.
Silty clay loam	CL or CH	A-6 or A-7		100	95 to 100	0. 20 to 0. 80	. 17	Moderate to high.

[3] Extremely deep.
[4] Below the normal sampled depth.

interpretations

the soil material is too variable for reliable estimates to be made]

Soil properties that affect suitability for—(Continued)						Degree of limitation for sewage disposal	
Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways		
Reservoir	Embankment					Septic tanks and filter beds	Sewage lagoons
Low seepage; can be used for excavated ponds.	Generally not applicable.	Ponding at times; slow internal drainage; outlets not available in all places.	High water-holding capacity; slow intake rate; adequate drainage necessary.	Not applicable.	Generally not applicable.	Severe: poorly drained.	Slight.
Seepage where substratum is exposed.	Fair to good stability; drains needed in places on toe slopes.	Occasional flooding.	Moderate water-holding capacity.	Diversion slopes are moderately erodible.	High erodibility; lack of fertility is a problem if subsoil is exposed.	Severe: subject to overflow.	Moderate: moderate permeability necessitates protection from overflow; subject to piping.
Seepage generally not important.	Fair to good stability; good moisture control necessary; impervious cores.	Fair to good internal and surface drainage.	High water-holding capacity; slow intake rate.	Moderate erodibility.	Moderate to high erodibility; lack of fertility is a problem if subsoil is exposed.	Moderate to severe: slow permeability.	Slight.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability—					Soil properties that affect suitability for—		
	As a source of		Of material for			Highway location	Foundations [1]	Dikes and levees
	Topsoil	Sand or sand-gravel mixture	Road subgrade		Road fill			
			Paved	Gravel				
Detroit (De)	Good	Unsuitable	Fair to poor.	Good	Fair to poor.	High susceptibility to frost action.	Fair to poor bearing capacity; subject to piping in places.	Erodibility; subject to piping in places.
Fillmore (Fm)	Fair	Unsuitable	Poor	Good	Poor	High susceptibility to frost action; 4 to 7 feet of fill needed in places; erodibility.	Good to poor bearing capacity.	Not applicable
Geary (GeB2, GeC2, GeC3, GeE, and GeE3).	Good	Fair for sand below a depth of 10 feet; unsuitable for sand-gravel.	Fair to poor.	Good	Fair to poor.	Very high susceptibility to frost action; erodibility.	Good to poor bearing capacity.	Not applicable
Hastings (Hs, HsA, HsB, HsC, Hs2, Ht, HtB2, and HtC2).	Good to fair.	Unsuitable	Fair to poor.	Good	Fair to poor.	High susceptibility to frost action; erodibility.	Good to poor bearing capacity.	Not applicable
Hobbs (Hb, HbA, and 2Hb).	Good	Unsuitable	Fair to poor.	Good to fair.	Fair to poor.	Very high susceptibility to frost action; subject to overflow; erodibility.	Good to poor bearing capacity.	Erodibility
Jansen (JaC, JsC2, JMC, JMC2, JMD, and JMD2. See Meadin series for Meadin part of JMC, JMC2, JMD, and JMD2).	Fair	Fair for sand below a depth of 3 feet; good for sand-gravel.	Good to fair.	Poor	Good to fair.	Moderate to high susceptibility to frost action; underlying material has low susceptibility to frost action; erodibility.	Good bearing capacity.	Not applicable
Kipp (Kipp part of WKC and WKC3).	Fair	Unsuitable	Poor	Good	Poor	Moderate susceptibility to frost action; erodibility.	Fair to poor bearing capacity.	Not applicable

interpretations—Continued

Soil properties that affect suitability for—(Continued)						Degree of limitation for sewage disposal	
Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways		
Reservoir	Embankment					Septic tanks and filter beds	Sewage lagoons
Seepage generally not important.	Fair to good stability; erodibility.	Fair to good surface and internal drainage.	High water-holding capacity.	Moderate erodibility.	Moderate erodibility.	Moderate: slow permeability.	Slight.
Low seepage; can be used for excavated ponds.	Not applicable.	Ponding; slow internal drainage in the subsoil; outlets not available in all places.	High water-holding capacity; slow intake rate; adequate drainage necessary.	Not applicable.	Generally not applicable.	Severe: slow permeability; poor drainage.	Slight.
Seepage in places.	Fair to good stability; impervious cores.	Fair to good surface and internal drainage.	High water-holding capacity.	Moderate erodibility.	Moderate erodibility; lack of fertility is a problem if subsoil is exposed.	Moderate to severe in more sloping areas: moderately slow permeability.	Moderate to severe on steep slopes.
Seepage generally not important.	Fair to good stability; impervious cores.	Fair to good surface and internal drainage.	High water-holding capacity.	Moderate erodibility.	Moderate erodibility; lack of fertility is a problem if subsoil is exposed.	Moderate to severe: slow permeability; slope.	Moderate to severe, depending on permeability and slope.
Seepage generally not important.	Fair to good stability.	Subject to overflow in places.	Moderate water-holding capacity.	Moderate erodibility.	Moderate erodibility.	Moderate; severe if soil is subject to overflow.	Moderate to severe: moderate permeability; overflow hazard.
High seepage below a depth of 2 feet.	Fair to good stability; erodibility; drains needed in places on flat slopes and on toe slopes.	Generally good surface and internal drainage.	Moderate water-holding capacity.	High erodibility; maintenance may be costly.	Erodibility; droughtiness; lack of fertility is a problem if substratum is exposed.	Moderate in more sloping areas.	Severe: rapidly permeable below a depth of 2 feet; construction costs high on steeper slopes; subject to piping.
Seepage in some places where limestone is exposed or is near the surface.	Fair to poor stability; erodibility; impervious cores.	Slow internal drainage.	Moderate water-holding capacity; slow intake rate; steep slopes.	High erodibility.	High erodibility; low fertility below the subsoil; construction and maintenance costs may be high.	Severe: moderately deep to limestone and shale.	Moderate to severe: limestone near the surface; steep.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability—					Soil properties that affect suitability for—		
	As a source of		Of material for			Highway location	Foundations [1]	Dikes and levees
	Topsoil	Sand or sand-gravel mixture	Road subgrade		Road fill			
			Paved	Gravel				
Kipson (KpD)	Good	Unsuitable	Fair to poor.	Good to fair.	Fair to poor.	Moderate susceptibility to frost action; erodibility.	Fair to poor bearing capacity.	Not applicable.
Lamo (Lb and 2Ly)	Fair	Unsuitable	Poor	Good	Poor	Very high susceptibility to frost action; 7 feet of fill needed in places.	Fair to poor bearing capacity.	Erodibility
Lancaster (LcD3)	Good to fair.	Unsuitable	Fair to poor.	Good to fair.	Fair to poor.	Moderate susceptibility to frost action; high erodibility.	Good to fair bearing capacity; subject to piping in places.	Slopes erodible; may be subject to piping.
Meadin (Mw)	Fair to poor.	Unsuitable for sand; good for sand-gravel below a depth of 3 feet.	Good to fair.	Poor	Good to fair.	Moderate to low susceptibility to frost action; high erodibility.	Good bearing capacity.	Not applicable.
Muir (Mu, MuA, MuB2, and MQ. See Meadin series for Meadin part of MQ).	Good	Unsuitable	Fair to poor.	Good	Fair to poor.	Very high susceptibility to frost action; erodibility.	Good to poor bearing capacity; subject to piping in places.	Not applicable.
Sandy alluvial land (Sx).								
Scott (Sc)	Fair	Unsuitable	Fair to poor.	Good	Fair to poor.	High susceptibility to frost action; subject to frequent ponding; 4 to 7 feet of fill needed in places.	Good to poor bearing capacity.	Not applicable.
Silty alluvial land (Sy).								
Wakeen (WeD, WKC, and WKC3).	Good	Unsuitable	Poor	Good	Poor	Moderate susceptibility to frost action; erodibility.	Good to fair bearing capacity.	Not applicable.

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

interpretations—Continued

Soil properties that affect suitability for—(Continued)						Degree of limitation for sewage disposal	
Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways		
Reservoir	Embankment					Septic tanks and filter beds	Sewage lagoons
Moderate seepage; high where limestone is near the surface.	Fair to poor stability: erodibility; impervious cores.	Surface drainage excessive at times.	Moderate water-holding capacity; erodibility; steep slopes.	High erodibility; construction costs may be high.	High erodibility; low fertility below a depth of 1½ feet; construction and maintenance costs may be high.	Severe: limestone near the surface; steep.	Severe: limestone near the surface; steep slopes make construction costly.
Seepage generally not important.	Fair to poor stability; erodibility.	Poor internal drainage; outlets not available in all places.	High water-holding capacity; slow intake; adequate drainage necessary.	Diversion slopes are erodible.	Not applicable.	Severe: slow permeability; high water table.	Slight.
Seepage in places.	Poor to good stability; drains needed in places on toe slopes.	May be excessively drained.	Moderate to low water-holding capacity; erodible; shallow; steep.	High erodibility; maintenance may be costly.	High erodibility; lack of fertility is a problem.	Severe------	Severe.
High seepage in places.	Fair to good stability; drains needed in places on toe slopes; subject to piping.	May be excessively drained.	Moderate water-holding capacity; erodible; droughty; steep.	High erodibility; maintenance may be costly.	High erodibility; lack of fertility is a problem.	Severe on steep slopes and where there is danger of contamination of water.	Severe: rapid permeability.
Generally low seepage.	Fair to good stability; impervious cores below the surface soil; erodibility.	Generally well drained.	High water-holding capacity; erodibility in more sloping areas.	Moderate erodibility.	Moderate erodibility.	Slight-------	Moderate to severe: moderate permeability and slope.
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Seepage not important.	Good to fair stability; erodibility	Frequent ponding; slow internal drainage; outlets not available in all places.	High water-holding capacity; slow intake rate; adequate drainage necessary.	Diversion slopes; erodible.	Not applicable.	Severe: slow permeability; poor drainage.	Slight.
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Moderate seepage where rock is exposed.	Fair to good stability; erodibility.	Surface drainage may be excessive; fair to poor internal drainage.	Moderate to high water-holding capacity; erodibility; steep.	Erodibility; construction and maintenance may be costly.	Moderate erodibility; lack of fertility is a problem if subsoil is exposed.	Severe: moderately slow permeability; steep.	Severe: steep slopes; proximity of rock.

Some of the soils are rated poor or fair as a source of topsoil because they are eroded, are low in natural fertility or are low in content of organic matter, or because their surface layer is heavy, sticky, and difficult to handle. Even though a soil is rated good as a source of sand or sand and gravel, considerable probing may be necessary to find material that has the particular gradation needed for a particular use.

The table gives ratings for the soils according to their suitability as road subgrade for bituminous or concrete pavement and for gravel roads. Because properly confined sand is the best subgrade for paved roads, the soil material is rated good if the AASHO classification is A–1. It is rated good to fair if the classification is A–2, fair to poor if A–4, and poor if A–6 or A–7.

The ratings for gravel subgrade apply to that part of the subgrade that receives gravel surfacing. Sand does not provide a stable surface, because it is not cohesive. All soils classified A–1 are rated poor, as well as those classified A–2 if they are not adequately plastic. Soils classified A–4 are rated good to fair, as are those classified A–2 provided they are sufficiently plastic. Silty or clayey soils that are classified A–6 or A–7 are rated good because they can be used in the upper part of the subgrade.

The ratings for road fill are based on about the same criteria as the ratings for subgrade for bituminous or concrete pavement.

The ratings for susceptibility to frost action, shown in the column describing soil properties that affect suitability for highway locations, are based on the texture of the surface soil and the subsoil. Clays and silts are susceptible to frost action if the underlying soil layers are pervious enough for water to rise and form ice lenses. In rating fine-grained soils that have a surface soil classified as ML, CL, or CH, the amount of clay material in the subsoil was considered. For example, if the surface soil is classified ML or CH and the subsoil is less than 40 percent clay (particles less than 0.005 millimeter in size), the soil is rated very high or high, respectively. Uniform fine sands that have a surface soil classified as SM and that contain less than 35 percent of fines (particles less than 0.074 millimeter in size) are rated low. Soils that are more than 3 percent but less than 10 percent particles finer than 0.02 millimeter in size are rated generally not susceptible. Those that are 3 percent or less particles finer than 0.02 millimeter in size are rated not susceptible.

Table 6 also gives interpretations of the properties affecting use of the soils in foundations, in dikes and levees, and in low dams. Suitability for foundations depends on bearing capacity and susceptibility to piping at a depth of more than 3 feet. Seepage and the need for sealing affect suitability for use in small dams. Compacted embankments are generally impervious and have fair to good stability. Toe drains are needed in places.

Properties that affect agricultural drainage are shown in table 6. Soils on bottom lands contain excess water because the water table is seasonally high or because the soils are slowly permeable, or both. A few areas are subject to flooding. Runoff is slow where the soils are level or nearly so.

Water-holding capacity and water-intake rate are the soil properties that affect irrigation. The rating for water-holding capacity is for the uppermost 4 feet of soil. It is high if more than 8 inches of water can be held in the topmost 4 feet. It is moderate if 5 to 8 inches can be held, low if 3 to 5 inches, and very low if less than 3 inches. Water intake refers to the amount of water absorbed, measured in inches per hour, when sprinkler or border irrigation is used and when the soil has a cover of alfalfa or grass in active growth. It is rated only if the rate is rapid or slow. A slow intake rate is less than half an inch per hour, and a rapid rate is 2 inches or more per hour. Irrigation hazards related to slope are not given, but this kind of information is contained in "Nebraska Irrigation Guide for Central and Eastern Nebraska," published in September 1959 by the Soil Conservation Service.

Terraces are commonly used in the county to conserve soil and water, because much of the cropped acreage is erodible. Diversions are used extensively to protect soils lying below terraces or grassland because many of the areas are very productive, even though they are highly erodible. Maintaining terraces in steep areas is expensive, but in most other places maintenance costs are reasonable.

Waterways are commonly used in the county. The most common hazard is erosion prior to the establishment of a grass cover. In many areas infertile soil material is exposed by deep excavation, and construction and maintenance costs are higher because vegetation is hard to establish and to maintain.

The suitability of the soils for winter grading is not rated, because most of the soils in the county are fine grained and hold too much water in winter to be handled.

Most residents in areas not served by urban sewage systems have septic tanks with filter beds. Some developers prefer to use sewage lagoons in new construction. The limitations of the soils for sewage disposal by both methods are given, and the limiting soil features are named.

Genesis and Classification of the Soils

This section discusses the major factors of soil formation as they relate to the soils of Thayer County and briefly explains the system of classifying soils into categories broader than the series.

Factors of Soil Formation

Soil is formed by the action of soil-forming processes on parent material. The characteristics of the soil are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time these forces have been active.

Climate and vegetation act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in some cases, determines it almost entirely. Finally, time is needed for the changing of parent material into a soil. It may be long or short, but usually, a long period of time is needed for distinct horizons to develop.

The factors of soil genesis are so closely interrelated that few generalizations can be made regarding the effect of any one factor because the effect of each is modified by the other four. Many of the processes of soil development are unknown.

Parent material

The soils of Thayer County developed in several kinds of parent material—alluvium, loess, water-deposited sand and gravel, and residuum weathered from limestone and sandstone.

The alluvium consists of valley sediments recently washed from uplands and deposited on flood plains and stream terraces. Soils of the Muir, Hobbs, Cass, and Lamo series developed in alluvium. They contain considerable organic matter, and they have retained the very dark color of the upland soils from which they were derived.

Peorian loess consists mainly of light-gray or yellowish-brown, silty material transported by wind. The thickness of these deposits ranges from a few feet to as much as 20 feet. Soils developed in Peorian loess have definite horizons indicating that soil-forming processes have been active over a long period of time. In this county soils formed in this material are well drained to poorly drained. The well-drained soils are those of the Crete and Hastings series. They have a dark-colored, friable surface layer and a brown or grayish-brown, moderately to strongly compacted, clayey subsoil. The poorly drained soils are those of the Butler, Fillmore, and Scott series, which occur in depressions. They have a dark-colored, leached, friable surface layer and a very dark brown or black, strongly compacted, clayey subsoil.

Another kind of loess in this county is Loveland loess, a reddish-brown material. It is older and more oxidized than Peorian loess and is slightly more sandy. Loveland loess generally underlies the Peorian, but it is at the surface in rather large areas in the southeastern part of the county in the general area between Gilead and Hubbell. It crops out on side slopes along most of the intermittent drainageways in the rest of the county. Soils of the Geary series developed in Loveland loess. Except for the decidedly reddish cast of their subsoil, they resemble soils of the Hastings series.

Water-deposited sand and gravel of Pleistocene age occur as a heterogeneous mixture. Soils of the Jansen and Meadin series formed in loess overlying this kind of sand and gravel. They occur on valley side slopes of the Little Blue River and along its larger, entrenched tributaries. In uneroded areas these soils contain enough organic matter to have a moderately dark colored surface layer. Their subsoil consists of loam or clay loam that has a pronounced reddish tinge, which is indirectly related to the overlying Loveland loess. The Jansen soils are moderately deep to sand and gravel. The Meadin soils are shallow to sand and gravel.

The limestone residuum in this county weathered from Greenhorn limestone (*3*), which consists of thin strata of medium-soft limestone interbedded with gray shale (fig. 14). This formation crops out in some of the eroded areas. Soils of the Kipson and Wakeen series formed in this material.

Graneros shale and the uppermost part of Dakota sandstone are exposed in areas south of Rose Creek. The Lancaster soils developed in material weathered from the reddish-brown, loosely indurated sandstone.

***Figure 14.*—An exposure of Greenhorn limestone, about 7 miles east of Hebron, along the Little Blue River.**

Climate

Climate affects the weathering of parent material directly through rainfall, fluctuation in temperature, and the working of wind. Water received as rainfall moves through the drainageways, continually shifting, sorting, and reworking unconsolidated material of all kinds. These sediments are deposited, picked up, and redeposited many times over by flowing streams. The alluvial soils in this county are examples of soils formed in water-deposited sediments. Alternate freezing and thawing hasten mechanical disintegration of parent material. Summer heat and humidity speed chemical weathering. Wind transfers soil material from one place to another. The extensive deposits of loess in this county are examples of the importance of wind as an agent of deposition of soil material.

Climate affects the soils indirectly through its influence on vegetation and the kinds of animal life that can be sustained. The primary source of the organic matter in a soil is vegetation. Animals that live in the soil help to convert dead leaves, stems, roots, and other plant remains to usable organic matter. Burrowing animals help to mix the various layers of soil.

The climate of Thayer County is characterized by moderately long and cold winters, cool springs with considerable precipitation, warm summers with many thunderstorms, and mild autumns with occasional rainy periods. The climate is fairly uniform throughout the county, and differences in the soils cannot be attributed to differences in climate. There are wide seasonal variations in temperature, as well as wide variations in the amount of rainfall. The temperature often falls below 0° F. in winter and soars to near 100° in summer. The annual average precipitation is 27 inches, and the mean temperature is 25° in winter and 78° in summer.

Plant and animal life

The soils of this county formed under mid and tall grasses. This kind of vegetation provides an abundant supply of organic matter that affects the physical and chemi-

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cal properties of the soils. The fibrous roots of these grasses penetrate the soil, make it porous, and encourage development of granular structure. The plant roots take up minerals in solution from the lower parts of the soil and eventually return them to the surface soil in the form of organic matter.

Micro-organisms are an important link in the transformation of undecomposed organic matter into humus. The action of bacteria and various kinds of fungi causes the decay of dead leaves and other organic matter. Earthworms and small burrowing animals help to mix humus with the soil. The presence of decayed organic matter gradually changes the physical and chemical composition of the surface soil.

Relief

Relief, or lay of the land, influences the formation of soil through its effect on runoff and drainage. Runoff is more rapid on steep slopes, and the soils are generally more severely eroded than in more gently sloping areas. Soil profiles are not so strongly developed in steep areas as they are on lesser slopes, even though the parent material is similar. Less water percolates through the soil, and plant growth is less vigorous. Soil horizons are thinner and less distinct than in less sloping areas. Lime is not so deeply leached in steep soils.

The strongly developed soils in this county occur in nearly level areas or in depressions, where there is little or no runoff. They are generally characterized by a leached surface horizon and a clayey subsoil.

Time

The time required for a soil to develop depends largely on the parent material. Some acid soils in the more humid regions form in a relatively short time; other soils—those that develop from freshly exposed limestone, for example—take a tremendously long interval of time. The finer the texture of the parent material the longer the time needed for soil formation. The finer textures retard the downward movement of water, which is necessary in the process of soil formation.

The youngest soils in Thayer County are those that formed in alluvium. These soils have little or no horizon development, because of the brief time their parent materials have been in place. The upland soils are much older and have been in place long enough for genetic profiles to develop and for horizons to have accumulated some thickness.

Classification of the Soils

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*7*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967. This system is under continual study, and readers interested in the development of the system should search the latest literature available (*5*, *8*).

Table 7 shows the classification of each of the soil series represented in Thayer County according to the present system, and also the great soil group according to the 1938 system.

The current system defines classes in terms of observable or measurable properties of soils. The properties chosen are primarily those that permit the grouping of soils that are similar in genesis. The classification is designed to encompass all soils. It has six categories. Beginning with the most inclusive, they are the order, the suborder, the great group, the subgroup, the family, and the series. They are briefly defined in the following paragraphs.

ORDER.—Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates.

SUBORDER.—Each order is divided into suborders, primarily on the basis of characteristics that seem to produce classes having genetic similarity. Mainly, these are characteristics that reflect either the presence or absence of water-

TABLE 7.—*Classification of soil series of Thayer County*

Series	Family	Subgroup and great group	Suborder	Order	Great soil group (1938 classification)
Butler	Fine, montmorillonitic, mesic	Abruptic Argiaquoll	Aquoll	Mollisol	Planosol.
Cass	Coarse-loamy, mixed, mesic	Fluventic Haplustoll	Ustoll	Mollisol	Alluvial.
Crete	Fine, montmorillonitic, mesic	Pachic Argiustoll	Ustoll	Mollisol	Chernozem.
Detroit	Fine, montmorillonitic, mesic	Pachic Argiustoll	Ustoll	Mollisol	Chernozem.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialboll	Alboll	Mollisol	Planosol.
Geary	Fine-silty, mixed, mesic	Udic Argiustoll	Ustoll	Mollisol	Brunizem.
Hastings	Fine, montmorillonitic, mesic	Udic Argiustoll	Ustoll	Mollisol	Chernozem.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustoll	Ustoll	Mollisol	Alluvial.
Jansen	Fine-loamy or sandy, skeletal, mixed.	Udic Argiustoll	Ustoll	Mollisol	Chernozem.
Kipp	Fine, mixed, mesic	Typic Argiustoll	Ustoll	Mollisol	Chernozem.
Kipson	Loamy, mixed, mesic, shallow	Entic Haplustoll	Ustoll	Mollisol	Lithosol intergrading to Regosol.
Lamo	Fine-silty, mixed, calcareous, mesic	Cumulic Haplaquoll	Aquoll	Mollisol	Alluvial.
Lancaster	Fine-loamy, mixed, mesic	Udic Argiustoll	Ustoll	Mollisol	Brunizem.
Meadin	Sandy, skeletal, mixed, mesic.	Entic Hapludoll	Udoll	Mollisol	Chernozem intergrading to Regosol.
Muir	Fine-silty, mixed, mesic	Pachic Haplustoll	Ustoll	Mollisol	Brunizem.
Scott	Fine, montmorillonitic, mesic	Typic Argialboll	Alboll	Mollisol	Planosol.
Wakeen	Fine, carbonatic, mesic	Typic Haplustoll	Ustoll	Mollisol	Chernozem.

logging or soil differences resulting from the climate or vegetation. The climatic range is narrower than that of the orders.

Great Group.—Each order is divided into great groups, on the basis of uniformity in the kinds and sequence of major horizons and similarity of the significant features of corresponding horizons. The horizons considered are those in which clay, iron, or humus have accumulated and those that have pans that interfere with the growth of roots or the movement of water. The features selected are the self-mulching properties of clays, soil temperature, chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like.

Subgroup.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and other groups, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in instances where soil properties intergrade outside the range of any other great group, suborder, or order.

Family.—Families are established within a subgroup primarily on the basis of properties important to the growth of plants, or the behavior of soils in engineering use. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

Series.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile. New soil series are established and concepts of some of the established series, especially the older ones, must be revised in the course of the nationwide soil survey program. A proposed series is given tentative status during the time its concepts are being studied at State, regional, and national levels of responsibility for soil classification. The Jansen and Lamo series, mapped in this county, had tentative status at the time this survey was sent to the printer.

General Nature of the County

The first permanent settlement in Thayer County was established in 1856 in the valley of Big Sandy Creek, near the present site of Alexandria. This community was along the Oregon Trail, which crosses the central part of the county.

The vegetation at that time consisted of mixed native grasses and strips of forest along drainageways. The early settlers built homes along the streams, where fuel and water were available. They spread westward and throughout the county, and by 1870 most of the land had been homesteaded. Farms replaced much of the grazing land. Many settlers moved out of the county in the early years because insects and drought caused repeated crop failures.

The boundaries of the county were established in 1872. The population reached a peak of 14,775 in 1910 but had decreased to 9,118 in 1960.

Relief and drainage

Thayer County is entirely within the Loess Plains, a part of the Great Plains physiographic province. The county was once mantled to varying depths by deposits of light-gray to yellowish-brown silty loess. Loess still covers most of the county, but in places it has been removed and the underlying formations exposed. The light-gray to yellowish-brown loess is underlain by reddish, slightly more sandy loess. The next lower formation is gray or reddish-brown loose sand or a heterogeneous mixture of sand and gravel. The bedrock underlying the sand and gravel consists mostly of interbedded shale and limestone but partly of pale reddish-brown sandstone.

The elevation of the county ranges from about 1,360 feet, where the Little Blue River crosses the eastern boundary of the county, to about 1,700 feet, near Byron in the southwestern part. The average elevation for the county as a whole is 1,540 feet.

The streams of the county flow eastward. The Little Blue River, the largest of the streams, drains the central part. Big Sandy Creek and the South Fork of Big Sandy Creek drain the northern part. Rose Creek drains the southeastern part, and Spring Creek, a tributary of the Little Blue River, drains the southwestern part.

Water supply

In the south-central and northern parts of the county the supply of underground water is good. These areas are generally underlain by more than 50 feet of water-saturated sand and gravel, and irrigation wells of relatively large capacity can be dug. In the southwestern corner of the county and extending northeasterly to the east-central part, the water-saturated sand and gravel is generally less than 20 feet thick, though it ranges in thickness from about 10 to about 50 feet. In this part of the county there are few areas where dependable irrigation wells can be dug. Another area unfavorable for irrigation wells extends from the east-central part of the county southward to the southeastern corner. In this area bedrock is fairly close to the surface, and there is little or no water-bearing material. Ground water resources in this area are insufficient for pump irrigation.

The supply of good-quality water for domestic use is adequate throughout the county. In the southeastern part of the county, where the water supply comes from the bedrock, the water is higher in mineral content. Several flowing springs in the valley of Big Sandy Creek, near Alexandria, supply water for livestock.

Transportation and markets

Two Federal highways, U.S. 81 (north and south) and U.S. 136 (east and west), cross the county. State highways 4 and 8 run east and west, one in the northern part and the other in the southern part. The State maintains hard-surface roads between all of the towns and villages.

Rural roads run along most section lines, except in the rougher parts of the county, and many of these roads are graveled. Rural mail routes reach all parts of the county.

Livestock auctions are held each week in Hebron and Deshler. The cattle and hogs sold are shipped by truck or rail to larger markets. Livestock not sold by local auction is marketed in Omaha or Kansas City.

Most of the poultry and dairy products are marketed locally. Grain and feed products not used or stored on the farms are sold to local elevator operators, who transport them by rail or truck to large markets. Some of the grain is stored in the local elevators.

Climate and its relation to crops[7]

Thayer County is near the geographical center of the United States. Its climate is typical of that near the center of a large continent: relatively warm summers, cold winters, and moderate rainfall that is highly variable in amounts. Table 8 shows temperature and precipitation data. Table 9 shows the probabilities of last freezing temperatures in spring and first in fall.

There are no topographic barriers to the north or south, and the wind shifts abruptly from south to north or from north to south and brings sharp changes in temperature. These changes are more noticeable in winter than in summer. Air masses moving into the region from the Pacific Ocean are moderated by the Rocky Mountains and arrive comparatively mild and dry. Nearly all of the moisture that falls in this county is brought in on warm, moist winds from the Gulf of Mexico or from the Caribbean.

Usually more than three-fourths of the annual precipitation falls during the active growing season, April through September. Precipitation is usually gentle, steady, and well distributed early in spring. As spring advances, more and more of the moisture falls as erratic thundershowers, and by the latter part of May nearly all of the precipitation is associated with thunderstorms.

Growing corn without irrigation is risky because droughty conditions are likely to develop by the third week of July, during the critical period when the corn is tasseling and silking. Corn grown on deep soils has a better chance of surviving until precipitation increases early in August. Some farmers adjust planting dates, hoping to bring the corn into tassel when moisture conditions are favorable. More than half of the acreage used for corn is irrigated.

The climate is favorable for growing winter wheat. The amount of precipitation decreases rapidly in fall, but usually there is enough moisture for wheat to make sufficient growth to carry it through the winter. In most years less than an inch of precipitation falls each month from December to February, but wheat is dormant at this time

[7] By R. E. MYERS, State climatologist, U.S. Weather Bureau.

TABLE 8.—*Temperature and precipitation data*

Month	Temperature[1]				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Average monthly total[1]	One year in 10 will have— Less than[2]—	One year in 10 will have— More than[2]—	Days with a snow cover of 1 inch or more[1]	Average depth of snow on days with snow cover[1]
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	34.5	12.6	55	−8	0.69	0.07	1.48	12	4.3
February	39.8	17.9	62	−2	.90	.14	1.66	10	4.4
March	49.4	27.2	75	9	1.55	.25	2.85	6	4.2
April	63.9	39.4	82	24	2.30	.65	4.54	1	2.1
May	74.1	50.7	89	35	4.18	1.56	6.85	0	----------
June	84.6	60.9	100	49	5.31	1.73	8.34	0	----------
July	91.7	66.0	103	56	3.24	.89	6.61	0	----------
August	90.5	64.9	103	54	3.07	.79	6.26	0	----------
September	80.4	54.1	96	38	3.25	.93	5.75	0	----------
October	69.8	42.7	85	28	1.58	.25	3.32	(3)	3.0
November	51.3	27.3	70	10	1.04	.02	2.61	2	2.9
December	39.6	18.5	58	−1	.76	.05	1.70	8	3.8
Year	64.1	40.2	[4]105	[5]−13	27.87	19.19	38.24	38	4.1

[1] Data based on period 1934 through 1963.
[2] Data based on period 1886 through 1963.
[3] Less than half a day.
[4] Average annual highest maximum.
[5] Average annual lowest minimum.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Hebron]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	April 3	April 11	April 18	May 1	May 14
2 years in 10 later than	March 28	April 6	April 12	April 25	May 8
5 years in 10 later than	March 18	March 27	April 2	April 15	April 28
Fall:					
1 year in 10 earlier than	November 3	October 24	October 16	October 7	September 27
2 years in 10 earlier than	November 9	October 30	October 21	October 13	October 2
5 years in 10 earlier than	November 20	November 8	October 31	October 23	October 11

and active growth does not begin until about the time spring rains normally arrive. Precipitation reaches its peak early in summer, normally when the wheat is heading and filling. Rainfall sometimes continues into harvesttime.

The high temperatures and intermittent rainfall in summer are less damaging to grain sorghum than to corn. Grain sorghum grows only a little during a period of drought but resumes active growth when it receives moisture. It is grown extensively as a dryland crop.

In most years southerly winds prevail in summer and bring in warm, humid air, but in some years the winds are from desert regions to the southwest, where the air is hot and dry. At such times the temperature is very high and the relative humidity is extremely low. Loss of moisture from the stalks and leaves damages corn plants, even though there is enough moisture in the root zone. In the drought years of 1934 and 1936, the flow of air was frequently from the southwest.

In some years thunderstorms are severe in spring and early in summer, and some are accompanied by local downpours, hail, and damaging winds. Many of the hailstorms cover an area only half a mile to a mile wide and 3 to 5 miles long. Damage to crops is often severe. Hailstorms in June and early in July damage wheat the most, because the heads have formed and are filling by that time. Hailstorms at this time strip the leaves from corn plants, sometimes nearly to the bare stalk. The young plants are capable of recovery, however, if favorable weather follows the storms. The storms are less frequent after the middle of July, but those that do occur inflict permanent damage on the corn crop.

Showers are lighter and less frequent in fall. Table 8 shows that the average monthly precipitation decreases from 3.25 inches in September to 1.58 inches in October, then to 1.04 inches in November. The drier weather and the abundant sunshine typical of the fall season favor the maturing crops and provide long, pleasant days for harvest.

Precipitation is generally light in winter, and most of it falls as snow, but there are several periods of rain or freezing rain each winter. Snow is often carried in on a strong, northerly wind that drops the temperature sharply and, before subsiding, piles the snow into drifts. Ordinarily, the snow cover remains only a short time, and it frequently disappears before the arrival of new snow. If puddles of water stand in wheatfields, or if the surface soil is very wet, repeated freezing and thawing sometimes kills the wheat.

The prevailing winds are from the north in January and February and are about evenly divided between north and south in March and April. They are from the south during the rest of the year. The annual average velocity is between 9 and 10 miles an hour. Spring is the windiest season; usually it has several days when the average velocity is 20 miles an hour or more. Such windy periods often persist for 2 or 3 days. Sustained windspeeds of as much as 20 miles an hour are infrequent in summer and fall. Peak windspeeds occur during severe thunderstorms. They are of short duration but are sometimes damaging. Windspeeds are lowest in winter, but at times a strong, northerly wind persists for 1 or 2 days in the wake of a cold front.

The following list shows the monthly rate of potential evapotranspiration. Computations were made by the Thornthwaite method (*6*) from mean temperatures at Hebron for the period 1934 through 1963. Figures are not given for the winter months, because the mean temperature is below 32 degrees in those months.

	Inches		*Inches*
March	0.35	August	6.02
April	1.76	September	3.69
May	3.59	October	1.99
June	5.31	November	.30
July	6.64		

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Bottom land. The normal flood plain of a stream, part of which may be flooded occasionally.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pastures, formed by cattle tracks or slippage of saturated soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizons above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Erosion (soil). The wearing away of the land surface by wind, running water and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the

growth of specified plants when other growth factors, such as light, moisture, temperature, and the physical condition (or tilth) of the soil, are favorable.

Genesis, soil. The manner in which a soil originated, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

O horizon. The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon. The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and it is therefore marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has (1) distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. The combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon. The weathered rock material immediately beneath the solum. This layer, commonly called the soil parent material, is presumed to be like that from which the overlying horizons were formed in most soils. If the underlying material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Leaching. The removal of soluble materials from soils or other soil material by percolating water.

Loess. A fine-grained eolian deposit consisting dominantly of silt-size particles.

Mottling. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Natural drainage. Refers to the conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time. Some of these soils commonly have mottling below 6 to 16 inches in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Parent material. The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction, because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil.

Surface planting. A method of planting row crops that leaves the soil relatively smooth and without ridges.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Tilth. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Terrace (agricultural). An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Till-plant. A tillage operation by which the soil is tilled and planted in one operation.

GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

[See table 1, page 5, for approximate acreage and proportionate extent of the soils and table 2, page 29, for predicted yields per acre of the principal crops. For facts about the engineering properties of the soils, turn to the section beginning on page 33]

Map symbol	Mapping unit	Described on page	Dryland capability unit: Symbol	Dryland capability unit: Page	Irrigated capability unit: Symbol	Irrigated capability unit: Page	Range site: Name	Range site: Page	Windbreak group: Name	Windbreak group: Page
Bu	Butler silt loam	6	IIw-2	24	IIs-2	28	Clayey	31	Silty to Clayey	32
By	Breaks-Alluvial land complex	6								
	Breaks	--	VIe-1	26	-----	--	Silty	30	Silty to Clayey	32
	Alluvial land	--	VIe-1	26	-----	--	Silty Overflow	30	Silty to Clayey	32
Ce	Crete silt loam, 0 to 1 percent slopes	8	IIs-2	24	IIs-2	28	Clayey	31	Silty to Clayey	32
CeA	Crete silt loam, 1 to 3 percent slopes	8	IIe-2	24	IIIe-2	28	Clayey	31	Silty to Clayey	32
CrB2	Crete silty clay loam, 3 to 7 percent slopes, eroded	8	IIIe-2	25	IIIe-2	28	Clayey	31	Silty to Clayey	32
Cs	Cass fine sandy loam	7	IIw-6	24	IIe-3	27	Sandy Lowland	30	Moderately Wet	32
Cv	Cass very fine sandy loam	7	IIw-3	24	I-1	27	Sandy Lowland	30	Moderately Wet	32
De	Detroit silt loam	9	I-1	23	I-1	27	Silty Lowland	30	Silty to Clayey	32
Fm	Fillmore silt loam	10	IIIw-2	25	IIs-2	28	Clayey Overflow	30	Moderately Wet	32
GeB2	Geary silty clay loam, 3 to 7 percent slopes, eroded	10	IIIe-1	25	IIIe-1	28	Silty	30	Silty to Clayey	32
GeC2	Geary silty clay loam, 7 to 11 percent slopes, eroded	11	IVe-1	25	------	--	Silty	30	Silty to Clayey	32
GeC3	Geary silty clay loam, 7 to 11 percent slopes, severely eroded	11	IVe-8	26	------	--	Silty	30	Silty to Clayey	32
GeE	Geary silty clay loam, 11 to 30 percent slopes	11	VIe-1	26	------	--	Silty	30	Silty to Clayey	32
GeE3	Geary silty clay loam, 11 to 30 percent slopes, severely eroded	11	VIe-8	26	------	--	Silty	30	Silty to Clayey	32
Hb	Hobbs silt loam, seldom flooded	14	I-1	23	I-1	27	Silty Lowland	30	Silty to Clayey	32
HbA	Hobbs silt loam, 1 to 4 percent slopes	14	IIe-1	24	IIe-1	27	Silty Lowland	30	Silty to Clayey	32
2Hb	Hobbs silt loam, occasionally flooded	14	IIw-3	24	I-1	27	Silty Overflow	30	Moderately Wet	32
Hs	Hastings silt loam, 0 to 1 percent slopes	12	I-1	23	I-1	27	Silty	30	Silty to Clayey	32
HsA	Hastings silt loam, 1 to 3 percent slopes	12	IIe-1	24	IIe-1	27	Silty	30	Silty to Clayey	32
HsB	Hastings silt loam, 3 to 7 percent slopes	12	IIIe-1	25	IIIe-1	28	Silty	30	Silty to Clayey	32
HsC	Hastings silt loam, 7 to 11 percent slopes	12	IVe-1	25	------	--	Silty	30	Silty to Clayey	32
Hs2	Hastings soils, eroded	13	IVe-8	26	------	--	Silty	30	Silty to Clayey	32
Ht	Hastings silty clay loam, 0 to 1 percent slopes	12	I-1	23	I-1	27	Silty	30	Silty to Clayey	32
HtB2	Hastings silty clay loam, 3 to 7 percent slopes, eroded	12	IIIe-1	25	IIIe-1	28	Silty	30	Silty to Clayey	32
HtC2	Hastings silty clay loam, 7 to 11 percent slopes, eroded	12	IVe-1	25	------	--	Silty	30	Silty to Clayey	32
JaC	Jansen loam, 7 to 11 percent slopes	15	IVe-1	25	------	--	Silty	30	Silty to Clayey	32
JMC	Jansen-Meadin complex, 5 to 11 percent slopes	15								
	Jansen soil	--	IVe-1	25	------	--	Silty	30	Silty to Clayey	32
	Meadin soil	--	IVe-1	25	------	--	Shallow to Gravel	31	Shallow	32
JMC2	Jansen-Meadin complex, 5 to 11 percent slopes, eroded	15								
	Jansen soil	--	IVe-8	26	------	--	Silty	30	Silty to Clayey	32
	Meadin soil	--	IVe-8	26	------	--	Shallow to Gravel	31	Shallow	32
JMD	Jansen-Meadin complex, 11 to 30 percent slopes	15								
	Jansen soil	--	VIe-1	26	------	--	Silty	30	Silty to Clayey	32
	Meadin soil	--	VIe-1	26	------	--	Shallow to Gravel	31	Silty to Clayey	32
JMD2	Jansen-Meadin complex, 11 to 30 percent slopes, eroded	15								
	Jansen soil	--	VIe-8	26	------	--	Silty	30	Silty to Clayey	32
	Meadin soil	--	VIe-8	26	------	--	Shallow to Gravel	31	Silty to Clayey	32
JsC2	Jansen sandy clay loam, 7 to 11 percent slopes, eroded	15	IVe-8	26	------	--	Silty	30	Silty to Clayey	32
KpD	Kipson soils, 11 to 30 percent slopes	17	VIs-4	26	------	--	Shallow Limy	31	Shallow	32
Lb	Lamo silty clay loam	17	IIw-4	24	IIw-4	28	Subirrigated	30	Moderately Wet	32
LcD3	Lancaster loam, 7 to 16 percent slopes, severely eroded	18	IVe-8	26	------	--	Silty	30	Silty to Clayey	32
2Ly	Lamo silty clay loam, drained	17	I-1	23	I-1	27	Clayey	31	Silty to Clayey	32
MQ	Muir-Meadin complex, 0 to 3 percent slopes	19								
	Muir soil	--	IIIe-3	25	IIe-3	27	Silty Lowland	30	Silty to Clayey	32
	Meadin soil	--	IIIe-3	25	IIe-3	27	Shallow to Gravel	31	Silty to Clayey	32
Mu	Muir silt loam, 0 to 1 percent slopes	19	I-1	23	I-1	27	Silty Lowland	30	Silty to Clayey	32
MuA	Muir silt loam, 1 to 3 percent slopes	19	IIe-1	24	IIe-1	27	Silty Lowland	30	Silty to Clayey	32
MuB2	Muir silt loam, 3 to 7 percent slopes, eroded	19	IIIe-1	25	IIIe-1	28	Silty Lowland	30	Silty to Clayey	32
Mw	Meadin loam, 3 to 30 percent slopes	19	VIs-4	26	------	--	Shallow to Gravel	31	Shallow	32
Sc	Scott soils	20	IVw-2	26	------	--	Clayey Overflow	30	Nonplantable	32
Sx	Sandy alluvial land	20	VIIs-3	26	------	--	Sandy Lowland	30	Nonplantable	32
Sy	Silty alluvial land	20	VIw-1	26	------	--	Silty Overflow; Silty	30	Moderately Wet	32
WeD	Wakeen silty clay loam, 11 to 30 percent slopes	21	VIe-1	26	------	--	Silty	30	Silty to Clayey	32
WKC	Wakeen and Kipp silty clay loams, 7 to 11 percent slopes	21								
	Wakeen soil	--	IVe-1	25	------	--	Silty	30	Silty to Clayey	32
	Kipp soil	--	IVe-1	25	------	--	Clayey	31	Silty to Clayey	32
WKC3	Wakeen and Kipp silty clay loams, 7 to 11 percent slopes, severely eroded	22								
	Wakeen soil	--	IVe-8	26	------	--	Silty	30	Silty to Clayey	32
	Kipp soil	--	IVe-8	26	------	--	Clayey	31	Silty to Clayey	32

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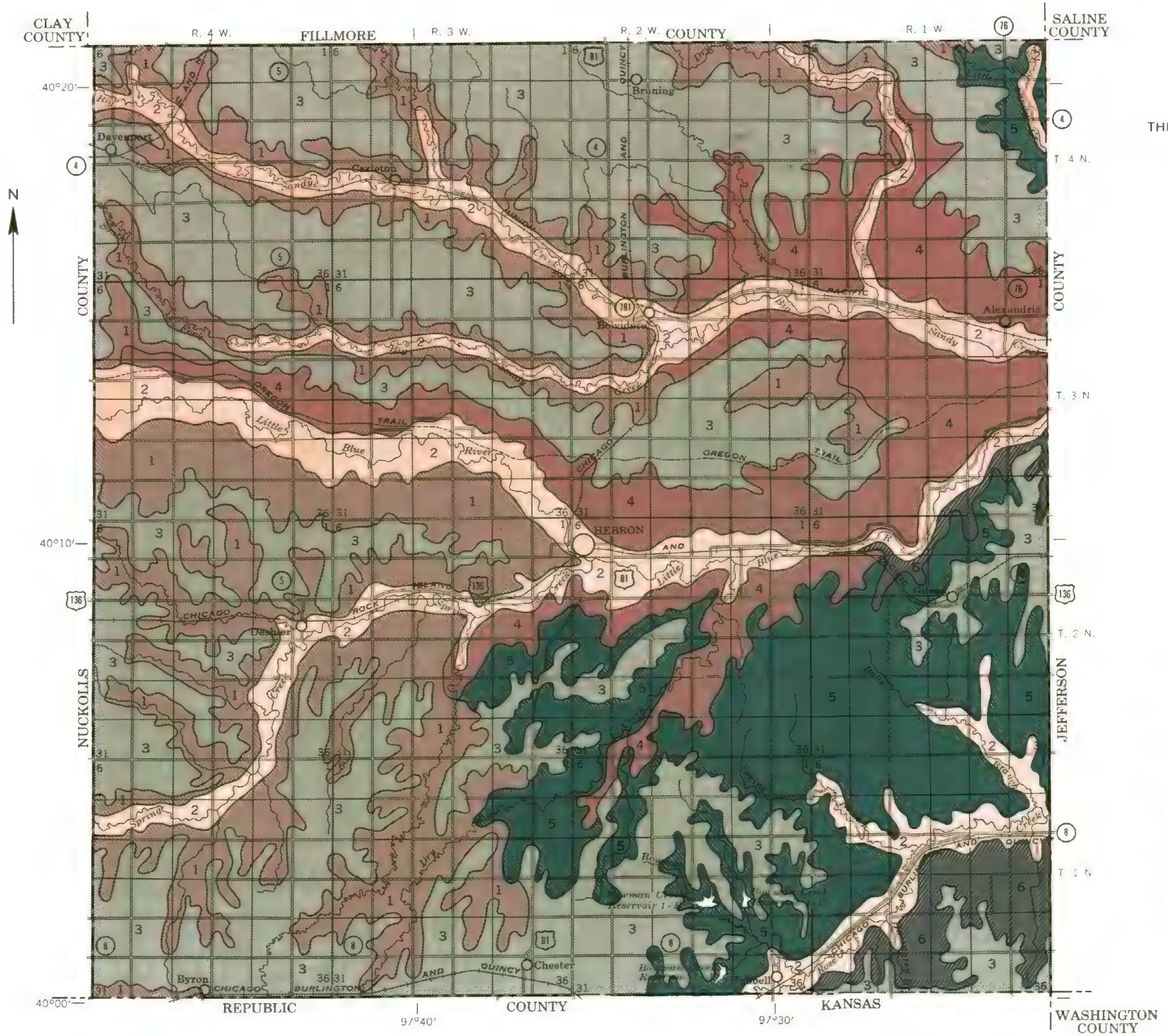


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
THE UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP
THAYER COUNTY, NEBRASKA

SCALE IN MILES

1 0 1 2 3 4

SOIL ASSOCIATIONS

1 Hastings-Geary association: Deep, strongly sloping, silty soils on uplands

2 Hobbs-Muir-Cass association: Deep, nearly level, silty soils on benches and bottom lands

3 Crete-Hastings-Butler association: Deep, nearly level soils that have a silty surface layer and a clayey subsoil; on uplands

4 Jansen-Meadin association: Moderately sloping to strongly sloping soils that are moderately deep or shallow to gravel; on uplands

5 Geary-Hastings association: Deep, moderately sloping to strongly sloping, silty soils on uplands

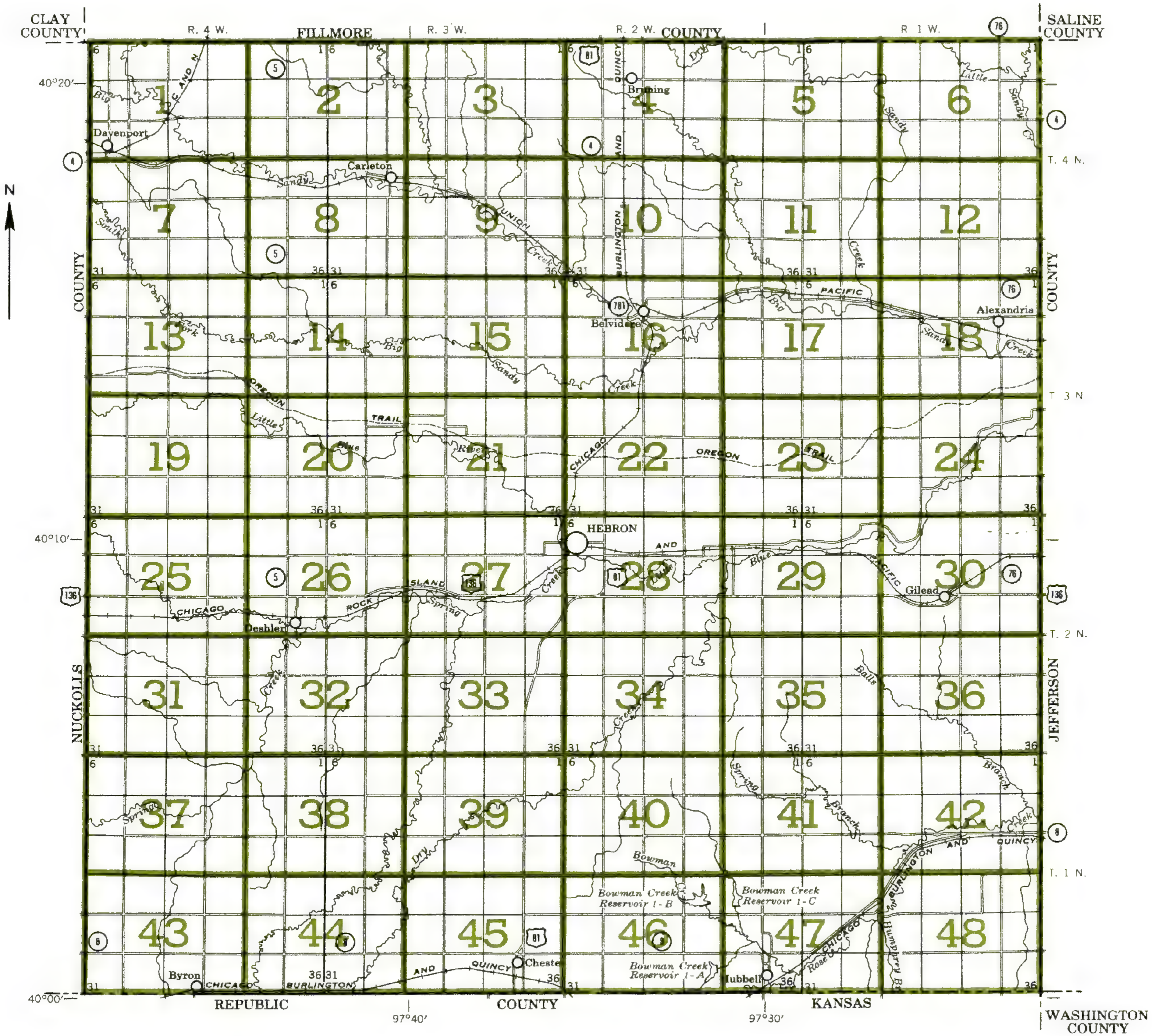
6 Kipson-Wakeen association: Shallow and moderately deep, steep soils overlying limestone; on uplands

July 1967

INDEX TO MAP SHEETS
THAYER COUNTY, NEBRASKA

SCALE IN MILES

1 0 1 2 3 4



SOIL LEGEND

Each soil symbol consists of letters or of letters and numbers; for example, By, JMC, JMC2, 2Hb. The last capital letter shows the slope if slope forms part of the soil name. A final number, 2 or 3, in the symbol shows that the soil is eroded or severely eroded.

SYMBOL	NAME
Bu	Butler silt loam
By	Breaks–Alluvial land complex
Ce	Crete silt loam, 0 to 1 percent slopes
CeA	Crete silt loam, 1 to 3 percent slopes
CrB2	Crete silty clay loam, 3 to 7 percent slopes, eroded
Cs	Cass fine sandy loam
Cv	Cass very fine sandy loam
De	Detroit silt loam
Fm	Fillmore silt loam
GeB2	Geary silty clay loam, 3 to 7 percent slopes, eroded
GeC2	Geary silty clay loam, 7 to 11 percent slopes, eroded
GeC3	Geary silty clay loam, 7 to 11 percent slopes, severely eroded
GeE	Geary silty clay loam, 11 to 30 percent slopes
GeE3	Geary silty clay loam, 11 to 30 percent slopes, severely eroded
Hb	Hobbs silt loam, seldom flooded
HbA	Hobbs silt loam, 1 to 4 percent slopes
2Hb	Hobbs silt loam, occasionally flooded
Hs	Hastings silt loam, 0 to 1 percent slopes
HsA	Hastings silt loam, 1 to 3 percent slopes
HsB	Hastings silt loam, 3 to 7 percent slopes
HsC	Hastings silt loam, 7 to 11 percent slopes
Hs2	Hastings soils, eroded
Ht	Hastings silty clay loam, 0 to 1 percent slopes
HtB2	Hastings silty clay loam, 3 to 7 percent slopes, eroded
HtC2	Hastings silty clay loam, 7 to 11 percent slopes, eroded
JaC	Jansen loam, 7 to 11 percent slopes
JMC	Jansen–Meadin complex, 5 to 11 percent slopes
JMC2	Jansen–Meadin complex, 5 to 11 percent slopes, eroded
JMD	Jansen–Meadin complex, 11 to 30 percent slopes
JMD2	Jansen–Meadin complex, 11 to 30 percent slopes, eroded
JsC2	Jansen sandy clay loam, 7 to 11 percent slopes, eroded
KpD	Kipson soils, 11 to 30 percent slopes
Lb	Lamo silty clay loam
LcD3	Lancaster loam, 7 to 16 percent slopes, severely eroded
2Ly	Lamo silty clay loam, drained
MQ	Muir–Meadin complex, 0 to 3 percent slopes
Mu	Muir silt loam, 0 to 1 percent slopes
MuA	Muir silt loam, 1 to 3 percent slopes
MuB2	Muir silt loam, 3 to 7 percent slopes, eroded
Mw	Meadin loam, 3 to 30 percent slopes
Sc	Scott soils
Sx	Sandy alluvial land
Sy	Silty alluvial land
WeD	Wakeen silty clay loam, 11 to 30 percent slopes
WKC	Wakeen and Kipp silty clay looms, 7 to 11 percent slopes
WKC3	Wakeen and Kipp silty clay looms, 7 to 11 percent slopes, severely eroded

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

BOUNDARIES

- National or state
- County
- Land division corners
- Reservation
- Land grant
- Small park, cemetery, airport

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent

Wells, water, irrigation

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions and sinkholes (Large, Small)
- Unclassified

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stony, very stony
- Rock outcrops
- Chert fragments
- Loveland outcrop
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Saline or alkali spot
- Steep slope or terraced soil

Soil map constructed 1966 by Cartographic Division, Soil Conservation Service, USDA, from 1962 aerial photographs. Controlled mosaic based on Nebraska plane coordinate system, south zone, Lambert conformal conic projection, 1927 North American datum.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 1

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division

Range, township, and section corners shown on this map are indefinite


2
FILLMORE COUNTY
R. 4 W. | R. 3 W.
N
Bethel Church
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 8)
T. 4 N.
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 3

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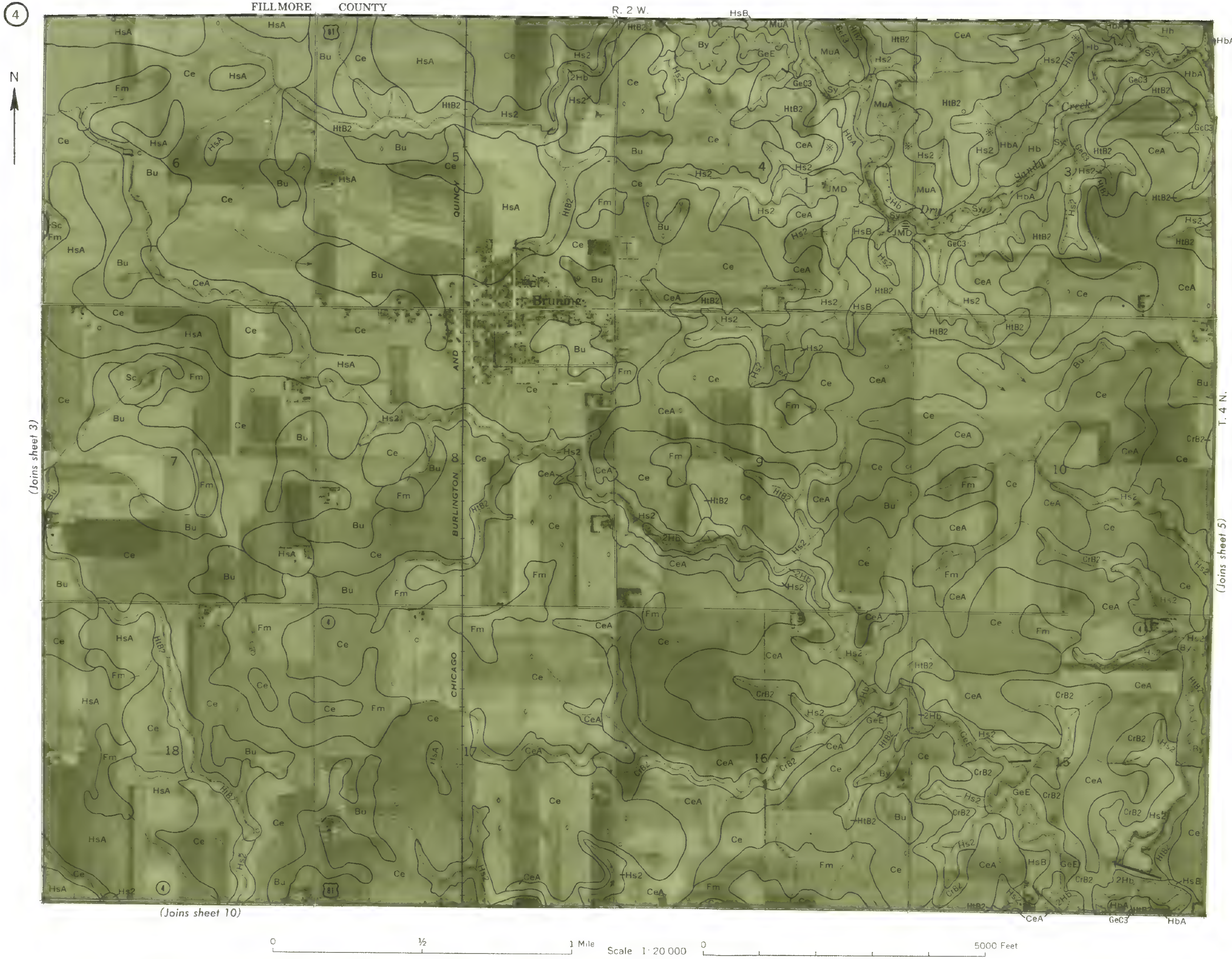
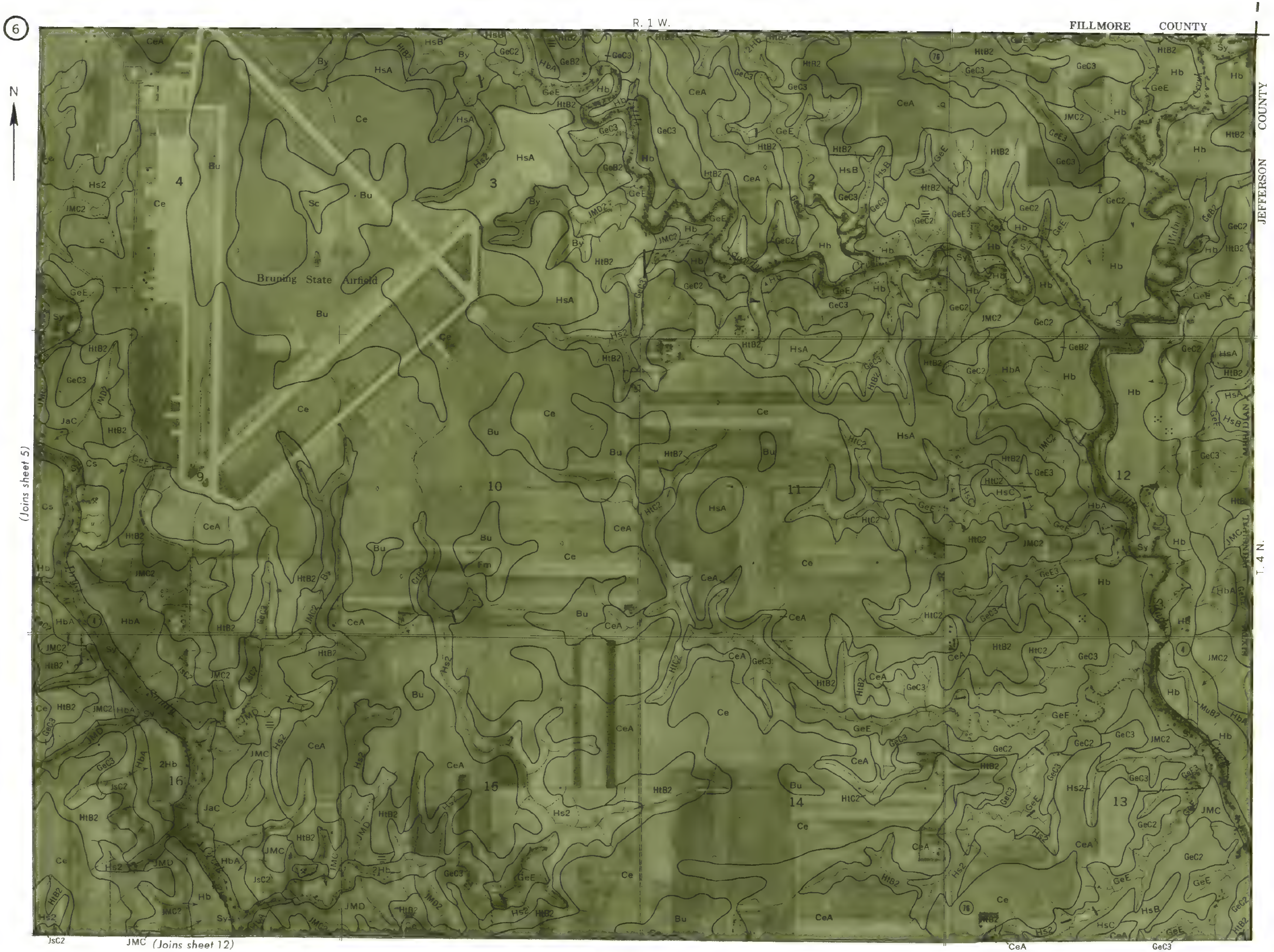

FILLMORE COUNTY
R. 2 W.
T. 4 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 10)
Bruning
QUINCY
BURLINGTON
AND
CHICAGO
Sandy Creek
N
Scale 1:20 000
0
½
1 Mile
5000 Feet


FILLMORE COUNTY
R. 2 W. | R. 1 W.
5
N
T. 4 N.
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 11)
GRAVEL PIT
GRAVEL PIT
GRAVEL PIT
Dry Sandy Creek
Hawks Field
PLEASANT PLAIN CEMETERY
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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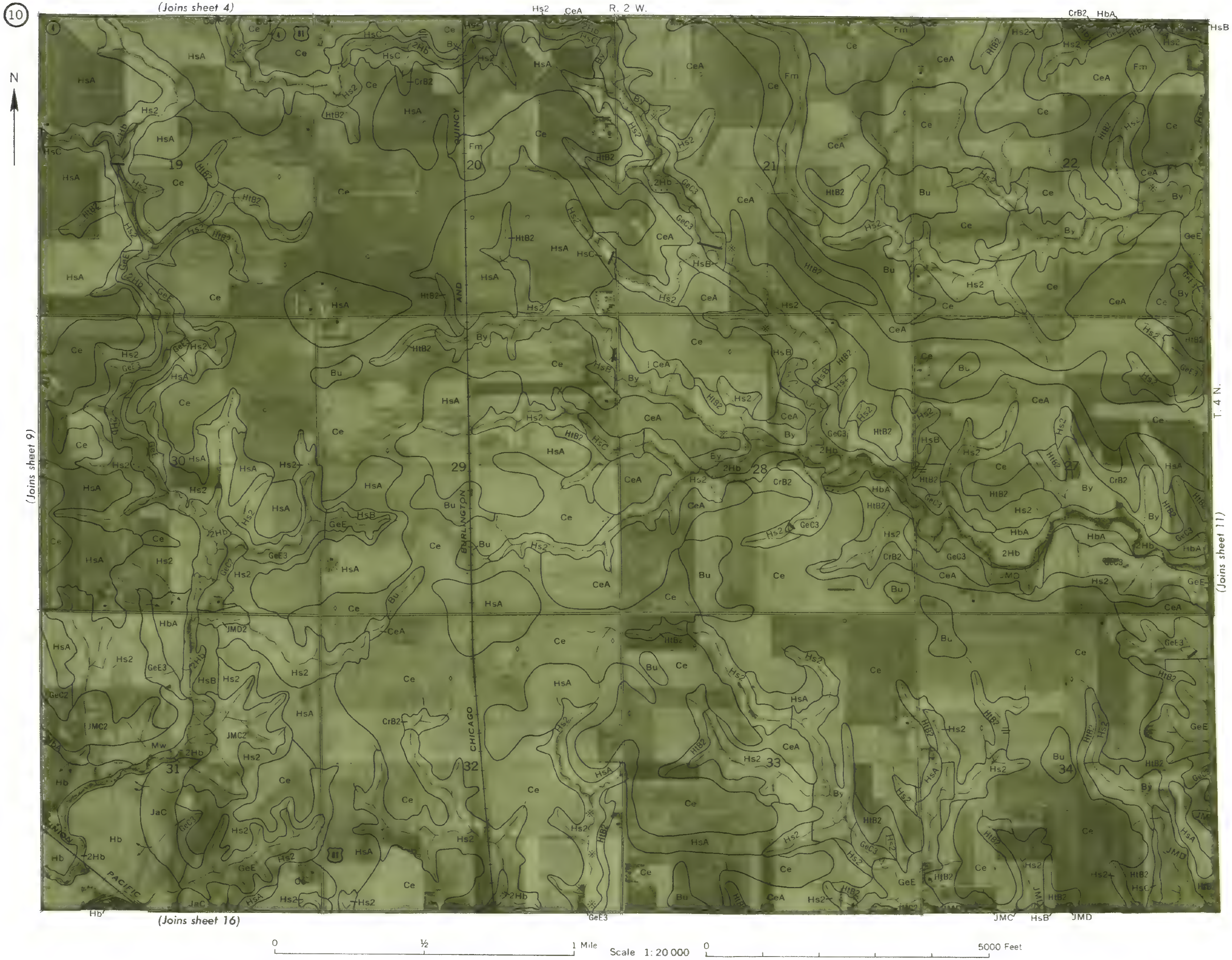
8
(Joins sheet 2)
R. 4 W.
R. 3 W.
N
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 14)
T. 4 N.
Big Sandy Creek
Union Pacific
Carleton
Carleton City Well
23
24
19
20
26
25
30
29
35
36
31
32
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 9


10
(Joins sheet 4)
R. 2 W.
N
(Joins sheet 9)
(Joins sheet 11)
T. 4 N.
(Joins sheet 16)
19
20
21
22
30
29
28
27
31
32
33
34
QUINCY
AND
BURLINGTON
CHICAGO
UNION
PACIFIC
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

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THAYER COUNTY, NEBRASKA NO. 11

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(12)

(Joins sheet 6)

R. 1 W.

N

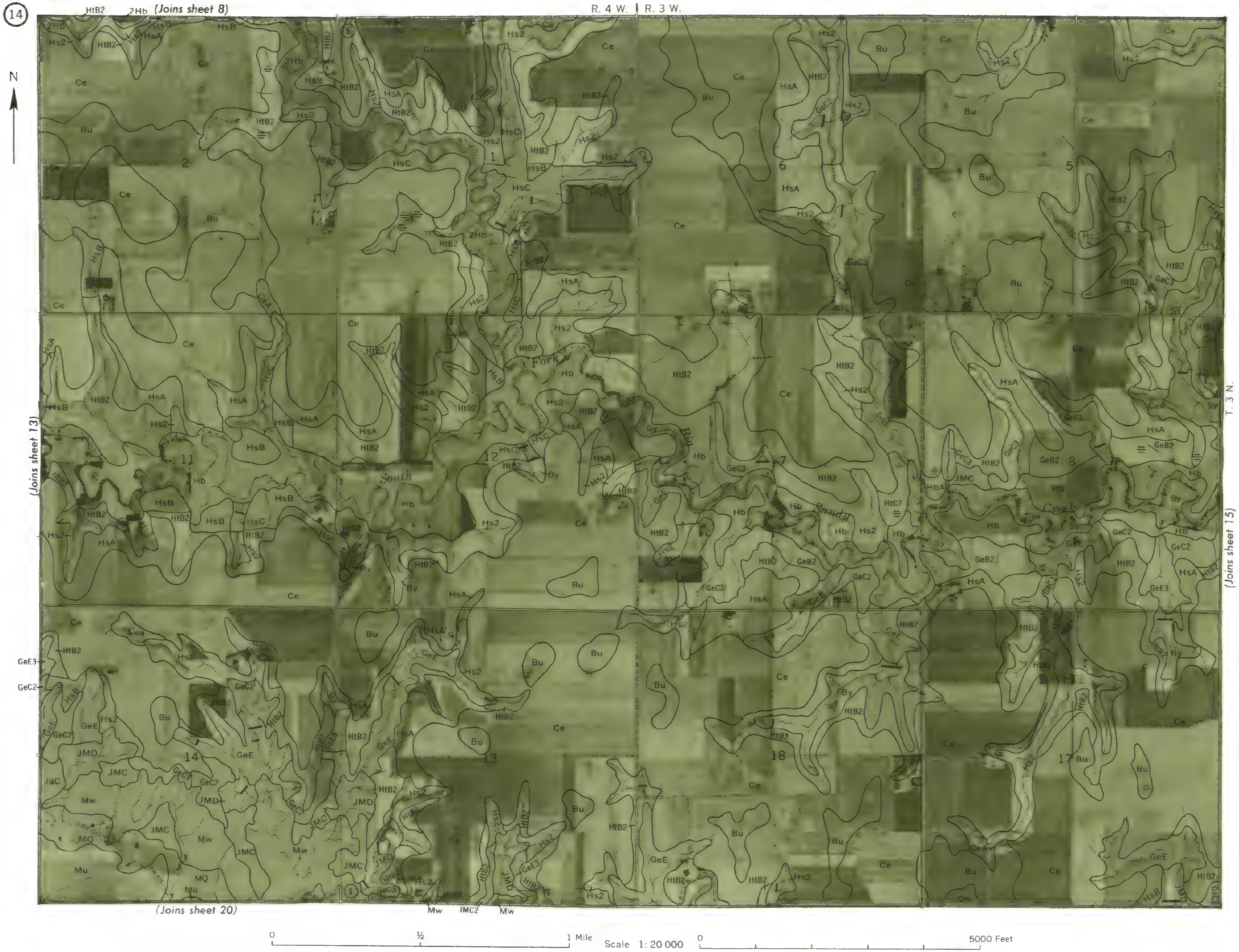
(Joins sheet 11)

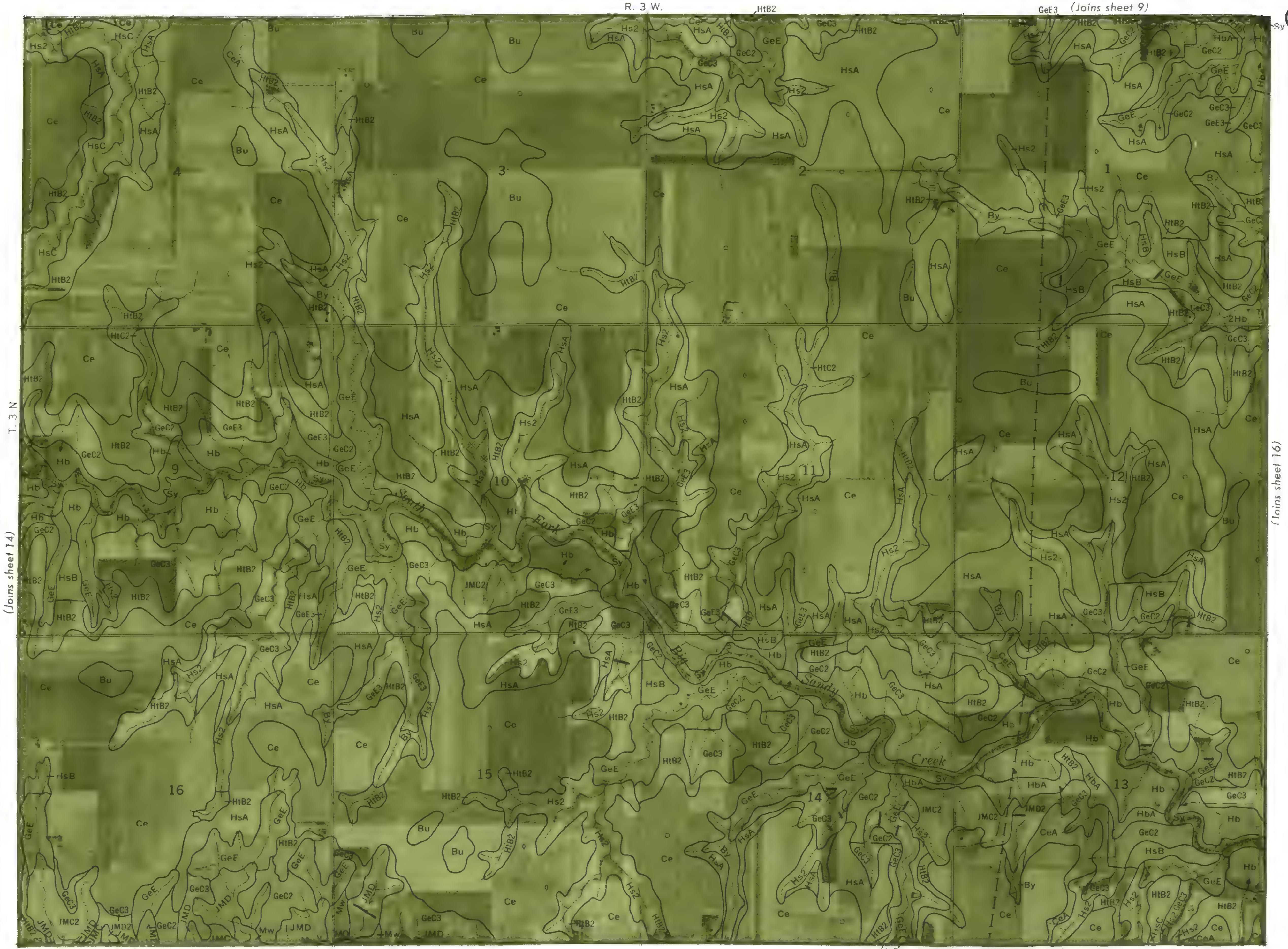
(Joins sheet 18)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 13

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


14
(Joins sheet 8)
R. 4 W. | R. 3 W.
N
(Joins sheet 13)
(Joins sheet 15)
T. 3 N.
(Joins sheet 20)
South Fork
Big Sandy Creek
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet



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C ½ 1 Mile Scale 1: 20 000 0 5000 Feet

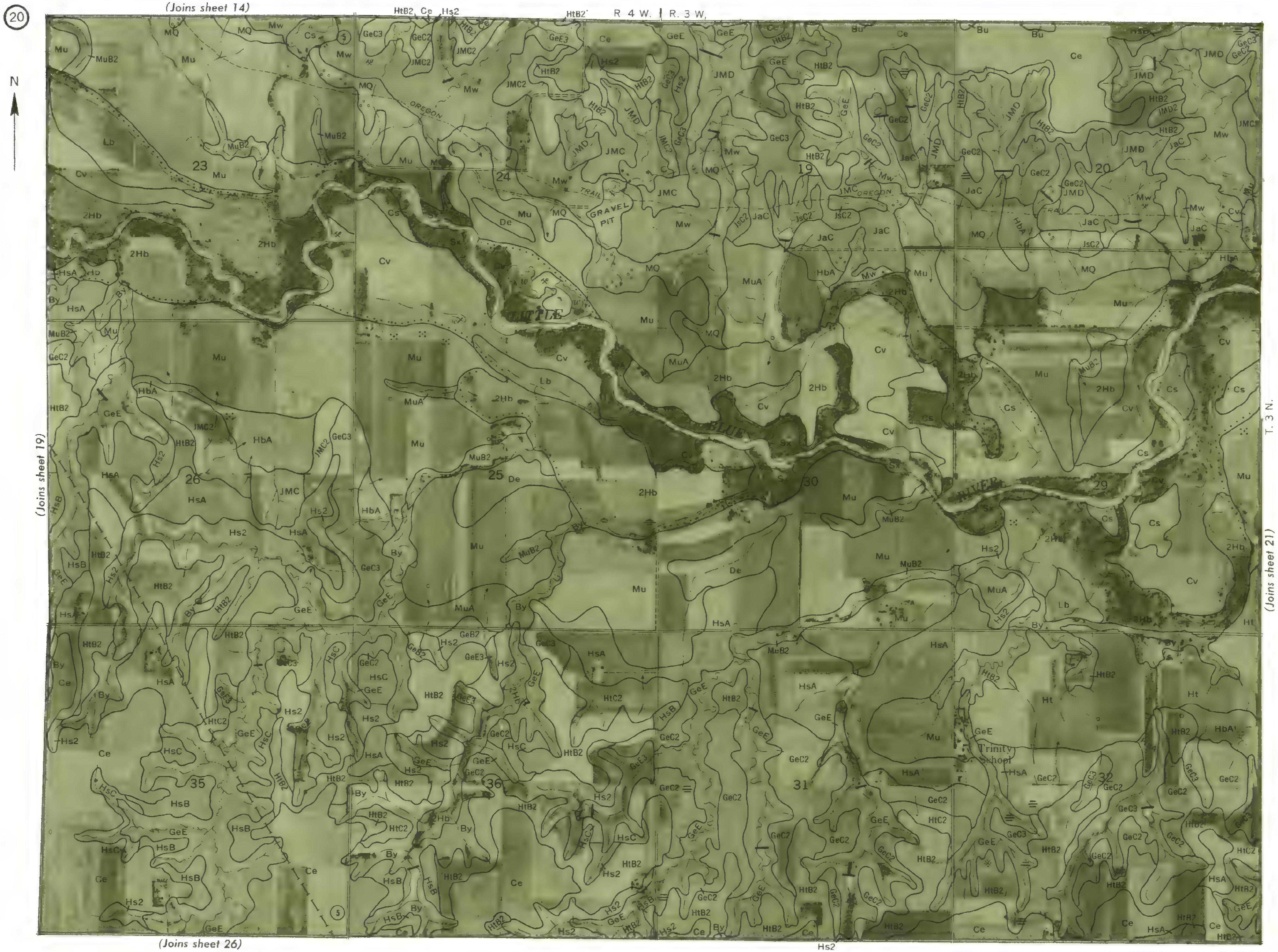
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

18

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA — SHEET NUMBER 19

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



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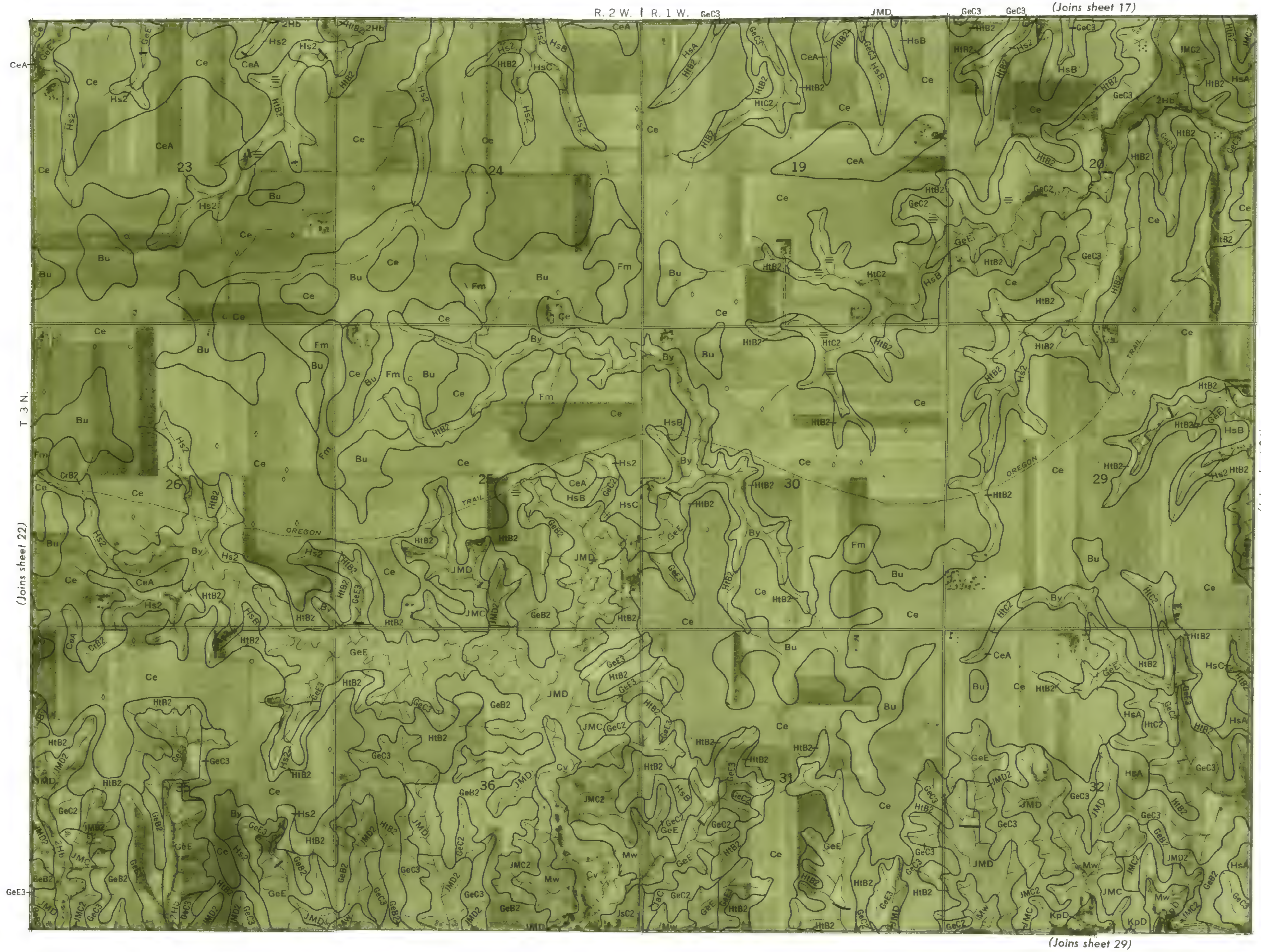
THAYER COUNTY, NEBRASKA NO. 21

THAYER COUNTY, NEBRASKA NO. 22

23



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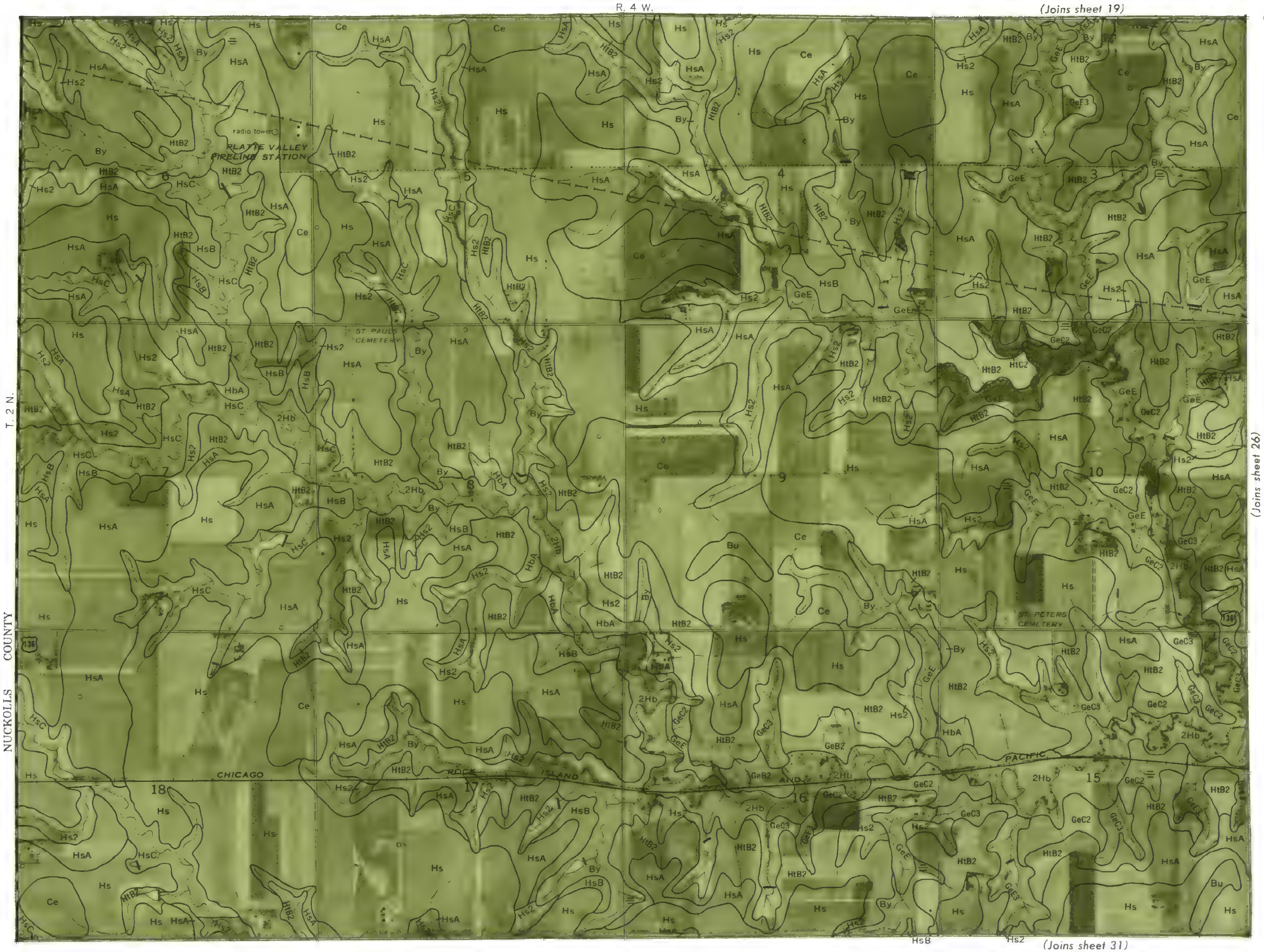
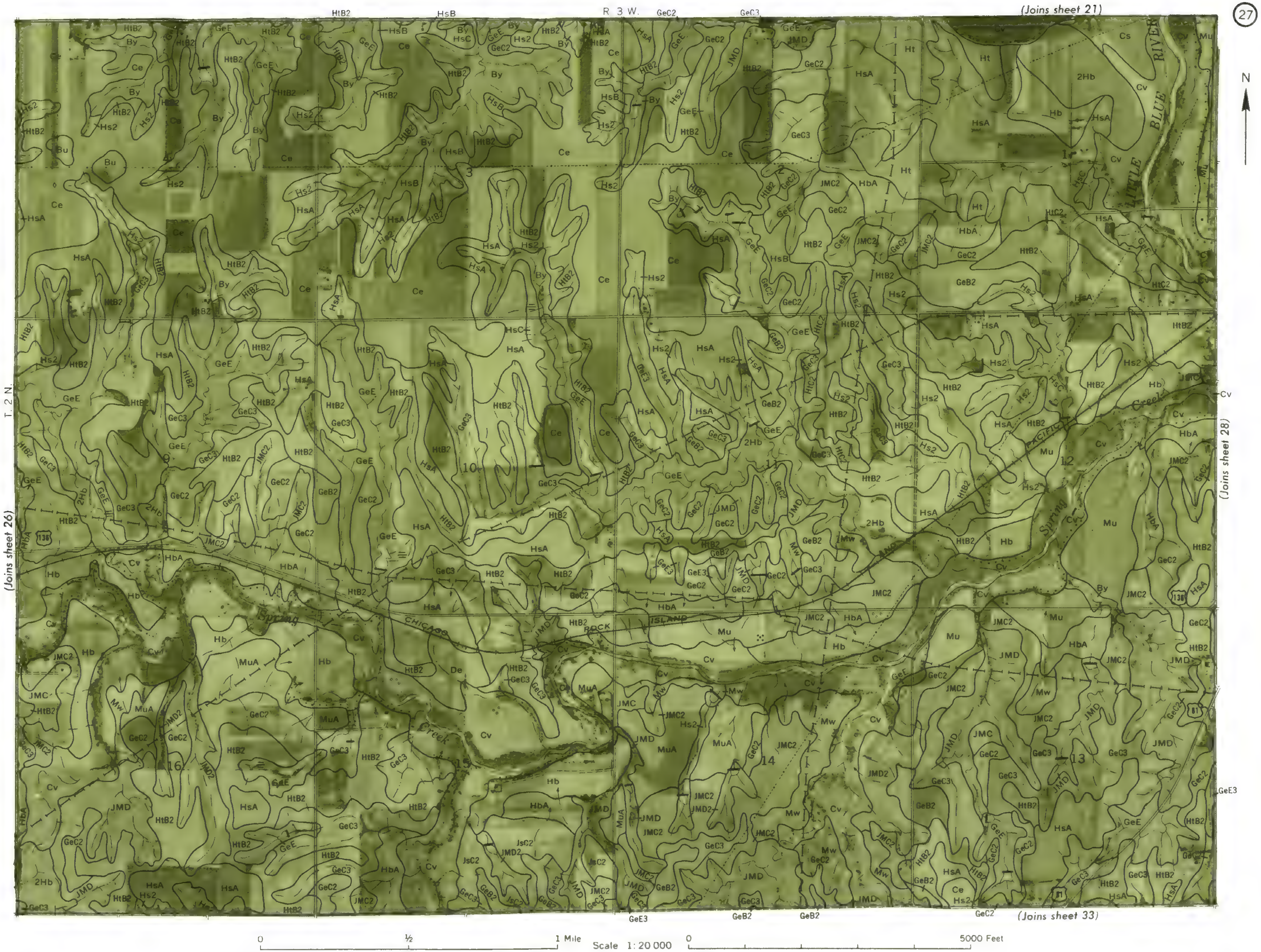
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 24



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet


26
(Joins sheet 20)
R. 4 W. | R. 3 W.
N
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 32)
T. 2 N.
Deshler
ST PETERS CEMETERY
CEMETERY
ROCK ISLAND
CHICAGO
PACIFIC
Spring
1
2
5
6
7
11
12
13
14
17
18
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

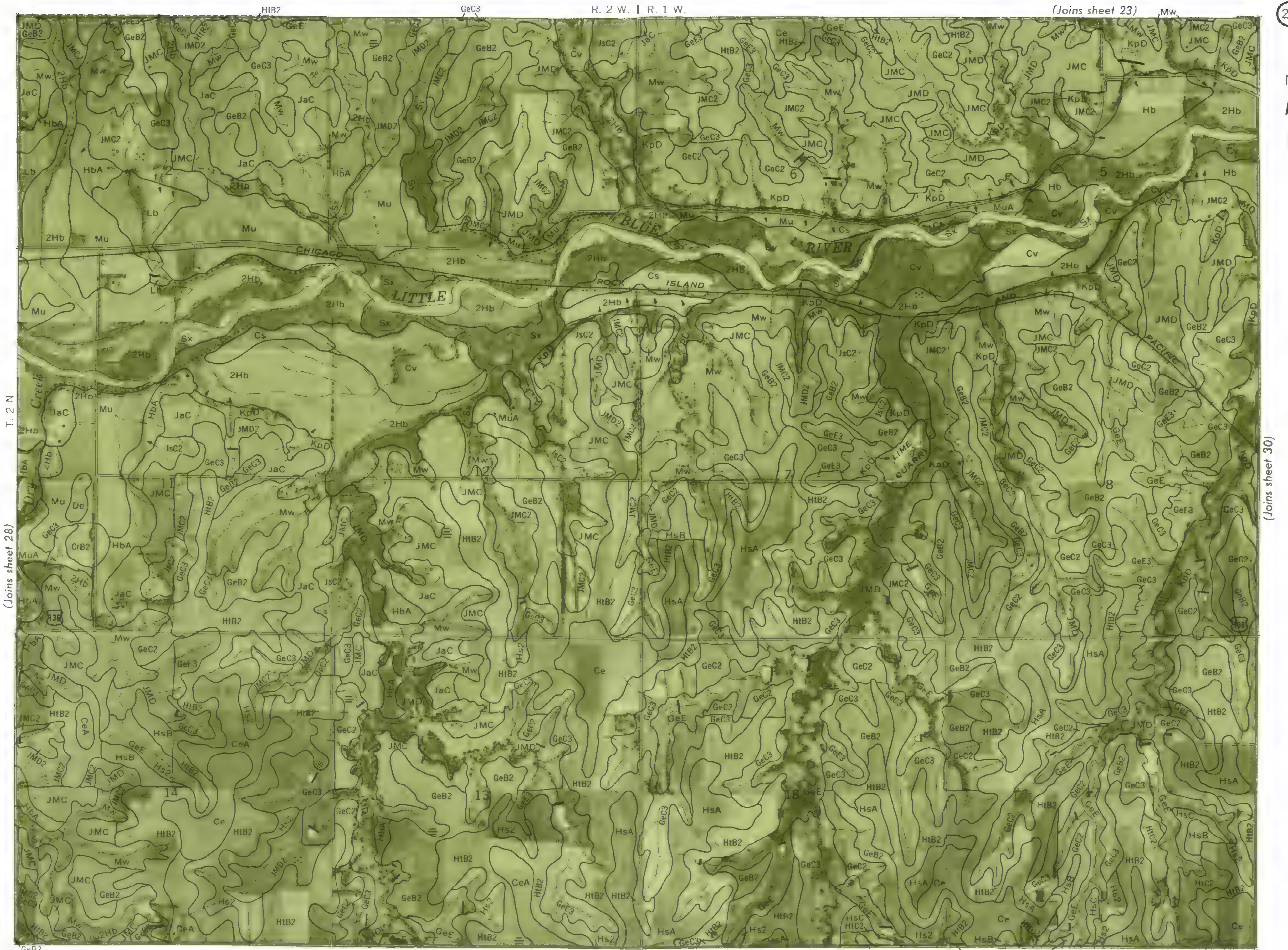

27
(Joins sheet 21)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 33)
R. 3 W.
T. 2 N.
N
LITTLE BLUE RIVER
CHICAGO ROCK ISLAND AND PACIFIC
Spring Creek
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

28

(Joins sheet 22)

(Joins sheet 34)

0 ½ 1 Mile Scale 1 20 000 0 5000 Feet



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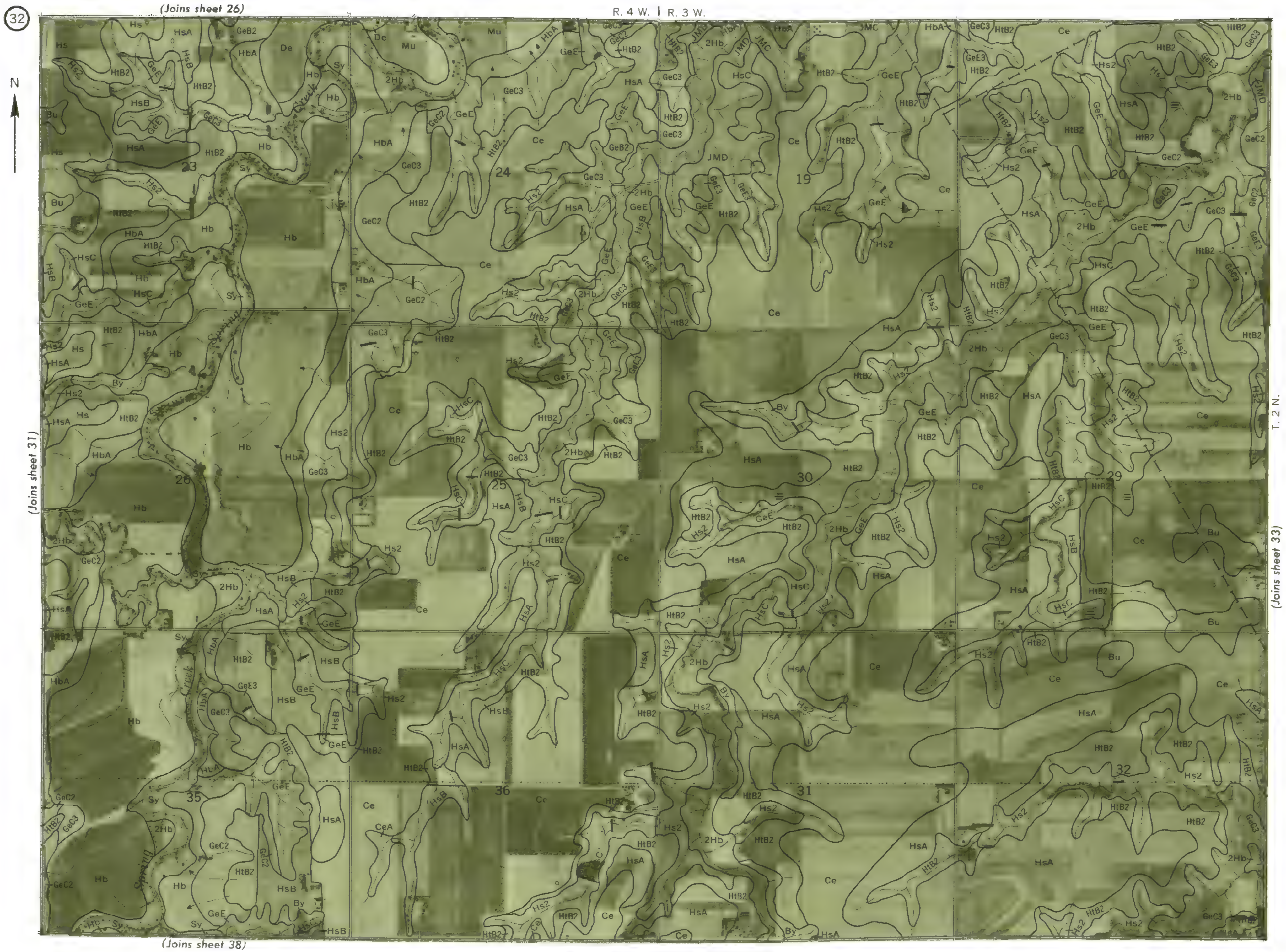
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

33

THAYER COUNTY, NEBRASKA NO. 33

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 34

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

R. 4 W.

(Joins sheet 31)

37

N

T. 1 N.

NUCKOLLS COUNTY

(Joins sheet 38)

(Joins sheet 43)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

38

(Joins sheet 32)

R. 4 W. R. 3 W.

N

(Joins sheet 37)

T. 1 N.

(Joins sheet 39)

(Joins sheet 44)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 38

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 39

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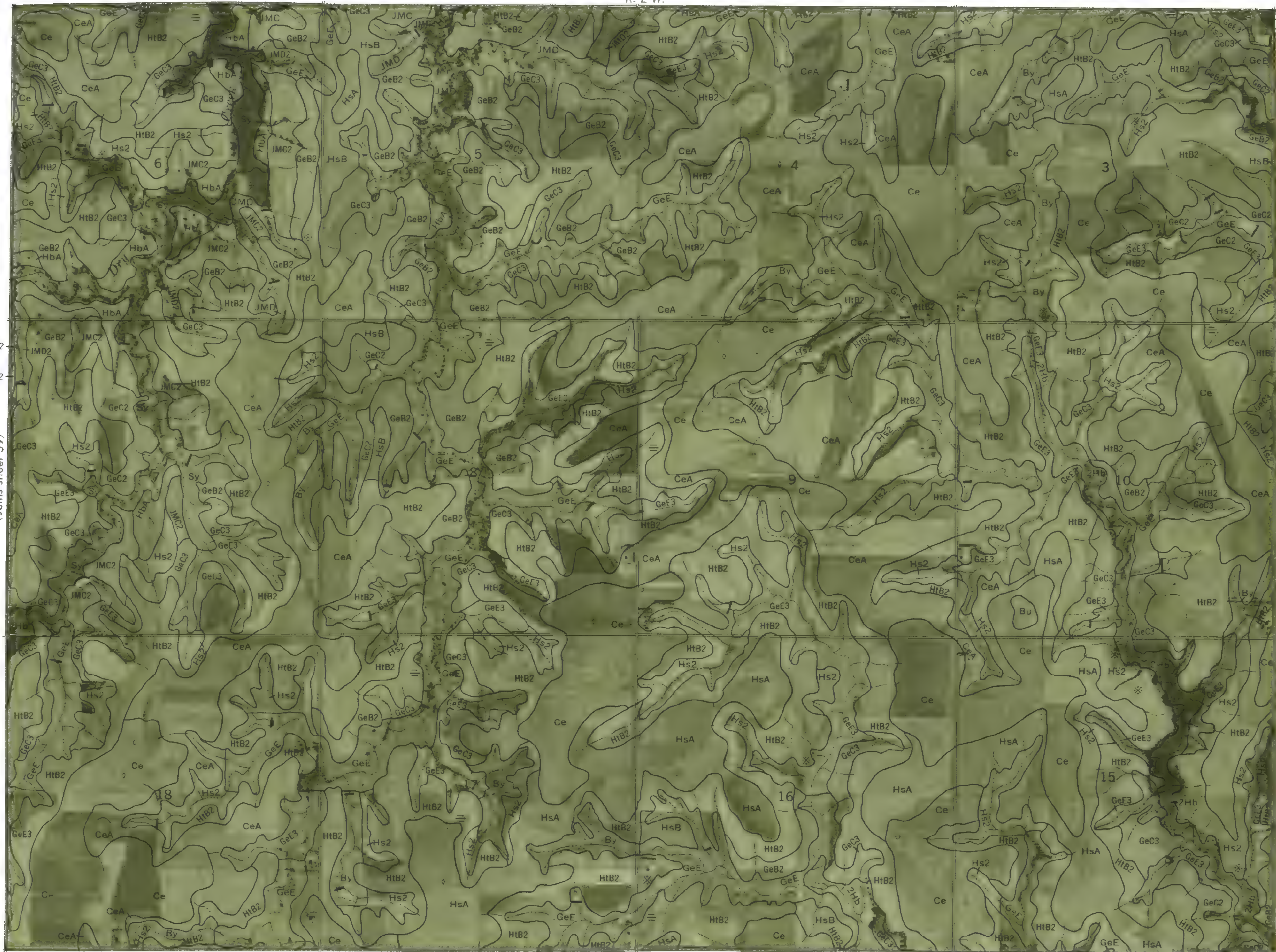
Range, township, and section corners shown on this map are indefinite

40

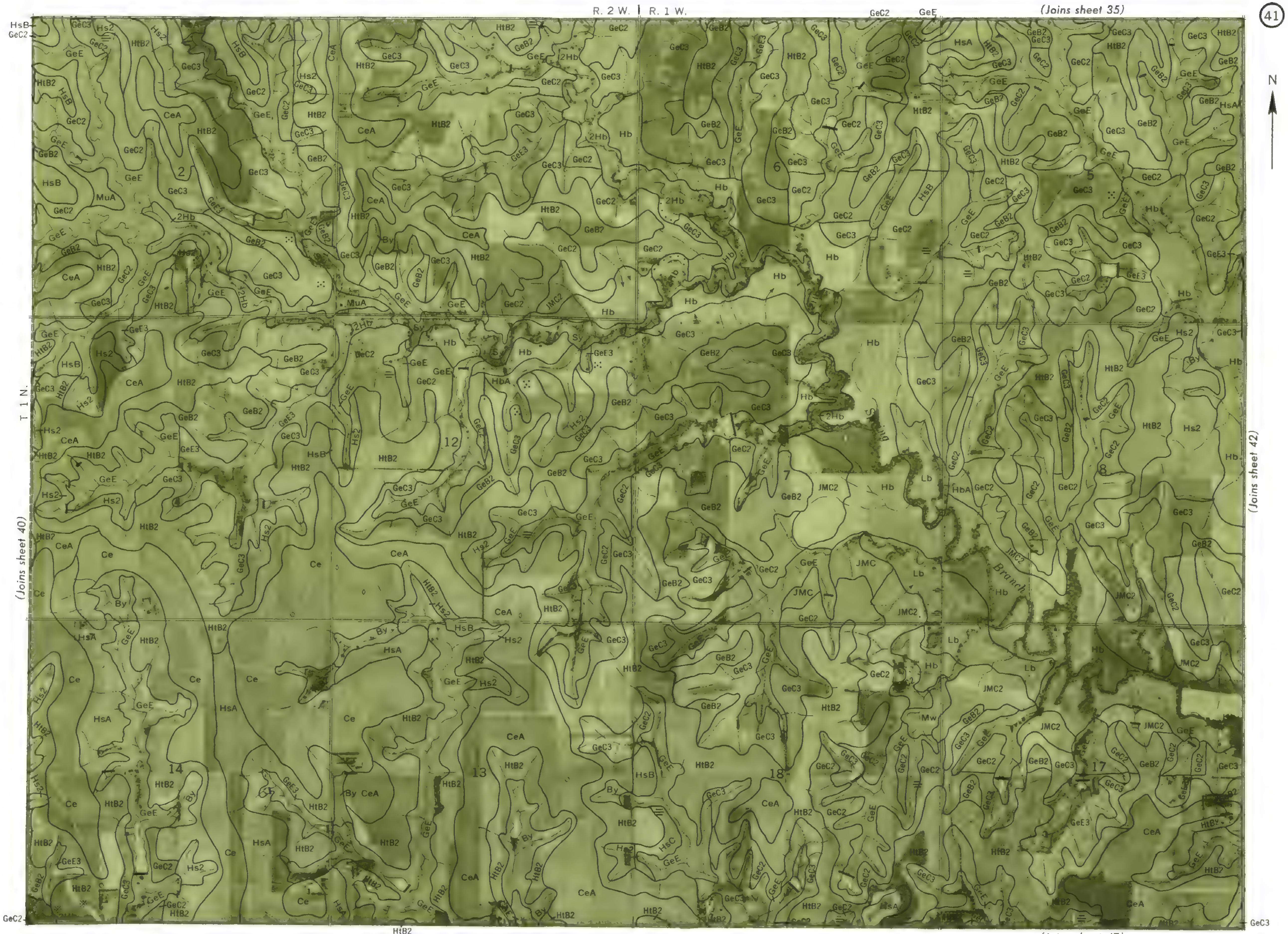
(Joins sheet 34)

R. 2 W.



(Joins sheet 46)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

42

(Joins sheet 36)

R. 1 W.

(Joins sheet 48)

KpD WKC WKC WKC

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.
Range, township, and section corners shown on this map are indefinite.

THAYER COUNTY, NEBRASKA NO. 43

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

45

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 45

46

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

THAYER COUNTY, NEBRASKA NO. 47

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

48

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet